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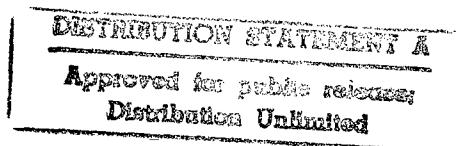
JPRS Report

Science & Technology

***China
S&T Policy***

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Science & Technology

China

S&T Policy

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21 October 1991

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Thoughts on Chinese S&T in the 21st Century

91FE0700B Beijing BEIJING KEJI BAO [BEIJING
SCIENCE AND TECHNOLOGY NEWS] in Chinese
5 Jun 91 p 3

[Article by Zhang Rufan [1728 3067 5400]]

[Text]

(I)

Time is zipping by, the days and months passing like a shuttlecock. We are now in the final decade of the 20th Century. It should be said that in the 20th Century, the world's science and technology entered an era of full-speed development. This is particularly true of the giant developments in electronics technology, nuclear technology, space technology, and information technology, which have brought revolutionary changes to mankind's production and living patterns and greatly spurred the world's technical progress and human civilization.

Science and technology are the first forces of production. S&T are also catalysts which change mankind's traditional life and work. People profoundly understand that, besides having a correct political line, the key to prosperity for a country and a nationality is having abundant economic strengths and powerful and modernized armed forces. Moreover, the economic strengths and powerful armed forces of a nation or a nationality also must come from modern S&T.

For China, while providing food and clothing for our population of 1.1 billion in the 40 years since our nation was founded, we have also made unprecedented and enormous accomplishments in developing science and technology. Because our basic industry is weak and our starting points in the natural sciences and technology were low, however, we still lag considerably behind the developed industrialized nations even today. From a temporal concept, the lag is 20 to 30 years. Since entering the 1990's, how should Chinese scientists develop explorations of China's S&T during the 21st Century? What should China's S&T levels in the 21st Century be? Can "S&T as the first forces of production" be solidly established in people's concepts? In particular, can it be resolutely adhered to by high-level policymakers?

(II)

Economic growth in all nations over the past several decades has not depended on strong physical labor and traditional industry. Instead, it relied on scientific and technical progress, which means the conversion of S&T into forces of production. Statistical data show that in 18th Century England, the ratio between the productivity of S&T and the productivity of manual labor was 4:1 and that by the mid-19th Century, this ratio had risen to 108:1, a 27-fold increase over 70 years. By the beginning of the 20th Century, S&T had become a powerful motive force in promoting social progress. The

contribution of technological progress in the industrialized nations to growth in national income was 5 to 10 percent in the early 20th Century and had grown to 50 to 70 percent by the 1970's. Recent statistical data from research done in foreign countries shows that capital contributes 18 to 20 percent to productivity, that labor factors contribute 10 to 18 percent, and that the minimum contribution of technology is 44 percent and the maximum is 72 percent. These statistical data show the great role of S&T in promoting social progress and improving national economic growth.

S&T, and in particular high technology, have become the primary factor in increasing a nation's economic strengths. As a result, many countries have formulated development plans like the United States' "Strategic Defense Initiative", Japan's "Basic Policy for Invigoration of Science and Technology", Western Europe's "Eureka Plan", the Soviet Union and Comecon's "Scientific and Technological Progress Program for the Year 2000", and so on. All of these would develop high technology to increase their own comprehensive national and economic strengths.

China's "863 Plan", "New Technological Revolution Countermeasures", and "Torch Plan" also propose strategic goals. However, I feel that China's reliance on S&T progress to promote social progress is a major issue that still requires resolution, both in conceptual terms and actions that cannot keep pace with the momentum of development on a world scale.

(III)

China's S&T white paper, the "China Science and Technology Guide", pointed out that "since the 3d Plenum of the 11th CPC Central Committee and as the focus of party work has shifted, historic changes have also occurred in China's S&T work. The CPC Central Committee and State Council have determined the basic principles for developing S&T in the new era, made decisions concerning reform of the S&T system, and readjusted the development strategy for S&T, and S&T are increasingly becoming powerful forces in modernization and construction."

The section of the "China Science and Technology Guide" concerning development of high technology pointed out that "we must adopt the principle of limited goals and key breakthroughs, formulate powerful policy measures, track world levels in certain key fields, try to make breakthroughs in fields where we have an advantage, serve the upgrading of existing traditional industry and the establishment of emerging industries, and gradually shift China's national economy onto a new technical foundation."

However, in actual work, there are still many problems that require further solution. S&T as the first forces of production has still not been accepted by all leaders. In using high-tech to transform traditional industry, because they are concerned with present economic benefits, many plant directors and managers are showing

signs of reluctance. Technology imports are extensive and indiscriminate and there is no attention to digesting and absorbing them. This is most acute in television production lines, refrigerator production lines, and washing machine production lines. There is considerable resistance to the transfer of high technology to civilian technology. High technology departments in military industry are not extending the high technology of their own industry but are instead working on large numbers of consumer appliance products. The military industry technology and space technology that audiences see television advertisements now are televisions, refrigerators, electric fans, and washing machines. Some people have criticized competition by high-tech departments with civilian industry. All these things are barriers which obstruct the entry of China's S&T into the economy and using S&T to develop the economy. We must resolve to eliminate them.

(IV)

The 21st Century will be a period of intense competition among all nations of the world. The main objective of this competition is to develop high and new technology and increase the economic strengths and military strengths of a country. This is especially important for China. We must track advanced world levels and make key breakthroughs. We cannot stop at articles and statements, but must instead have a clear strategic objective. Relying on our own efforts and arduous struggle are the virtues and requirements of the Chinese people, but we cannot abandon the entry of science and technology into our economy or abandon raising the material and cultural living standards of all our people. The Gulf War once again shows that engaging in modern warfare is actually a measure of high-tech strengths. Thus, China's national defense modernization must also be armed with high technology.

This shows that we must conscientiously develop S&T and make focusing on developing S&T the primary affair of the entire party, the entire army, and all our people. In other words, developing S&T is a major life and death issue for the Chinese nationality. We cannot slack off, nor can we employ all sorts of excuses to obstruct S&T work.

On the eve of entering the 21st Century, all nations of the world are seeking countermeasures for the existence and development of their own countries and the invigoration of their nationalities, readjusting development strategies, eliminating old traditional concepts, and entering a new world order.

A program is also necessary for updating the knowledge of S&T personnel. During the last half of the 20th Century, science and technology developed very fast and one renewal basically was required about every 10 years. Applying S&T in actual production or carrying out technical upgrading also must lag behind the conversion of S&T into commodities for a period of time. For us,

therefore, making S&T truly become forces of production is not something that can be easily done. Thus, there is a great deal of work to be done from ideology to understanding and from understanding to implementation.

(V)

What should science and technology be like in China in the 21st Century?

1. We should attain the levels of the advanced industrialized nations in microelectronics, nuclear technology, space technology, information technology, biotechnology, and new materials technology.

2. Chinese industry should use modern S&T for upgrading to reduce costs, increase economic benefits, and raise productivity. Computer controlled production automation and semi-automated production lines should be commonplace in specialized production plants.

3. Change from a labor-intensive model to technology-intensive model in plants and enterprises. Place economic development on a foundation of S&T development.

4. State investments in S&T should account for over 10 percent of our GNP. Plants and enterprises which lack the capacity for S&T upgrading or plants and enterprises which have poor results and squander resources should be closed, shut down, combined, or converted.

5. We should raise the quality of S&T and culture of our entire nationality. China's college undergraduates now account for just 11 in 10,000 at present, which obviously is too few. This is the root cause of China's scientific and technological backwardness. By the 21st Century, China's college undergraduates should account for 100 in 10,000 of our total population and college undergraduates studying the natural sciences should account for over 80 in 10,000.

6. Science and technology have no national boundaries. We should draw upon advanced technology from all nations in the world and use this to reduce our lag behind the advanced nations and take fewer detours. International cooperation and a division of labor in S&T have already become an important basis for present and future S&T development work and invigoration of a country's economy.

7. As we enter the 21st Century, there will be a development model of S&T—economic development—social stability—environmental coordination. At that time, the world will see S&T competition and competition of economic strengths. Thus, China should immediately readjust foreign and domestic policies and make new interpretations of slogans that have been proposed in the past.

8. The development of S&T in China should be oriented toward the future and should begin now in doing much

leading work. This means that S&T should walk at the forefront of other work. Having S&T follow the conventional way of doing things and develop in synchronization with other sectors of the national economy in essence means lagging behind.

9. We should further advocate scientific decisionmaking and democratic decisionmaking. We should further foster academic democracy and technical democracy. Focus on S&T policies and laws, develop strategic research.

10. We should focus on management work. Management is a science. Management produces results. Management itself is a primary factor in promoting S&T development. We should acknowledge that present management levels in China are backward compared to those in the developed industrial nations and that Chinese management measures are still restricted to traditional "leadership deployments, implementation by administrative departments; formulating plans at the start of a year and doing summaries at years' end". Scientific management has not received attention yet.

11. We must conscientiously focus on quality work. We must use quality to gain victory in economic construction and in conquering international markets.

(VI)

Science and technology are the first forces of production. As we enter the 21st Century, S&T strengths will be a primary indicator for assessing a country. Thus, how to do S&T work at present is a question that must be resolved now.

For example, the state now invests too little in S&T work. The main thing now for scientific research units is solving the problems of insufficient scientific research funds and find ways to obtain money. I think we should continue to provide certain conditions for key scientific research units to ensure the completion of state tasks on schedule. This means providing specific inputs for scientific research units.

Second, we should be concerned with the question of the circulation of S&T personnel. In China, many S&T personnel have left their scientific research posts for a variety of reasons. Moreover, many S&T personnel have flowed out to Hong Kong or foreign countries, and the Taiwan administration has also begun recruiting mainland S&T personnel recently. Thus, we must have a policy prevent the loss of S&T personnel.

Third, we should implement rewards for successful personnel who have promoted S&T progress. The problem of brain inversion has still not been resolved.

Internationalization of 'Spark' Plan Considered

91FE0819D Beijing ZHONGGUO KEJI LUNTAN
[FORUM ON SCIENCE AND TECHNOLOGY IN
CHINA] in Chinese No 4, 18 Jul 91 pp 42-45

[Article by Kong Deyong [1313 1795 8673] and Gao Xiaosu [7559 4607 5685]: "Some Thoughts on Internationalization of the 'Spark' Plan"]

[Text]

I. The Time Is Basically Mature for Internationalization of the "Spark" Plan

Organization and implementation of the "Spark" Plan for 5 years has been significantly effective in the extension of advanced and applied technology into rural areas and invigoration of the rural economy. At the same time, we have accumulated mature technologies, products, technical equipment, and management experience and formed our own special operational mechanisms, and the preliminary conditions are in place for a shift toward foreign countries, especially Third World countries. Achievements in the "Spark" Plan have attracted attention from the United Nations. In 1990, the UN's Economic and Social Commission for Asia and the Pacific [ESCAP] made a special visit to China to examine the "Spark" Plan and its inspection report pointed out that through the "Spark" Plan, China has found and is now taking a new route. It also felt that the beneficial experiences in the "Spark" Plan provide sufficient source material for extending the policies, ideas, and methods in China's "Spark" Plan to other countries of the Asia-Pacific region. Members of ESCAP felt that there are broad prospects for its extension in interested countries when their local research capacities, socioeconomic conditions, and S&T development levels permit. Thus we must hold detailed discussions of the possibility of transferring it. As soon as we have an appropriate transfer target, we should encourage them and make arrangements satisfactory to both parties. The deputy secretary of the UN has requested that this inspection report be turned over to all developing nations in the Asia-Pacific region and expressed the hope that they will cooperate with China in extending the "Spark" Plan to Third World countries, thereby providing an effective international support environment for internationalization of the "Spark" Plan. Thus, whether we are speaking of present development levels of the "Spark" Plan or analyzing its international effects, the time is now mature for internationalization of the "Spark" Plan.

Moving the "Spark" Plan into the world would help improve China's international status, effectively unite the people of developing nations, and further improve China's international image. Thus, this is not just technical and economic work. It is also a matter with major political significance.

II. Favorable Conditions for Internationalization of the "Spark" Plan

A. There is great potential for technology transfers to developing nations.

With the rapid development of science and technology and the strengthening of international economic cooperation, international technology transfers have become a major characteristic of the world economy at the present time and they have global and universal qualities. However, technology transfers require mutual coordination of technology with the related environmental factors. Excessive economic, industrial, and cultural differences pose enormous problems and hard to predict obstructions for international technology transfers. It is precisely for this reason that technology exports from the United States to the European Community, Japan, Canada, and other developed nations have continually risen as a proportion of the total volume of technology exports, increasing from 50 percent in the 1960's to more than 80 percent in the mid-1980's. The withdrawal of the developed nations from the technology transfer markets of developing nations provides us with an opportunity. Moreover, because the volume of technology trade among the developing nations at present accounts for less than 10 percent of the total volume of world technology trade, this shows that there is major potential that can be exploited.

B. "Spark" technology is particularly attractive to developing nations in technical levels, appropriateness, performance/price ratios, and other areas.

Economic development levels and the quality of labor power in China's rural areas are about the same as those in other developing nations, especially developing countries in the Asia-Pacific region. We have already made the corresponding changes during the process of transferring "Spark" technology from scientific research academies and institutes to rural areas in order to adapt to the rural environment and conditions. Thus, when compared to technology in the developed nations, "Spark" technology is better suited to the needs of developing nations and is more attractive to them in technological appropriateness, complexity of technical equipment, ease of operation, and performance/price ratio of technology transfers. Moreover, China has a vast rural area with a huge population and natural and geographical conditions that extend from frigid zones to subtropical zones. Corresponding to this, "Spark" technology also is capable of satisfying the special needs of all categories of developing nations because of its great variety and ability to adapt to all sorts of unique and harsh requirements.

For the developed nations, there are also possibilities of taking over partial markets for labor-intensive "Spark" technology products and China's unique grain and oil foodstuff product processing machinery and technology, such as bean product processing technology and equipment.

C. Out-shipments of "Spark" Plan management software will have profound effects on Third World countries.

During 5 years of practice in the "Spark" Plan, we have gradually formed a set of planning and management mechanisms, the main ones including: 1) Macro guidance and market regulation planning mechanisms; 2) Organizational management mechanisms led by science and technology committees and with participation by many parties; 3) Capital operational mechanisms with micro capital guidance, capital raising by many parties, and integration of finance with S&T; 4) Technical operational mechanisms which link supply and demand and promote the rapid conversion of advanced appropriate technology into forces of production; 5) Personnel training mechanisms that are concerned with results and train appropriate personnel; 6) Development mechanisms with phases and levels that use "Spark" projects as a tap and link lines, zones, and areas to gradually form regional support industries and industry groups.

This complete set of operational mechanisms together with the principles of "short, easy, and fast" for establishment of "Spark" projects, an input arrangement for rational deployment of capital, technology, equipment, and personnel, and a development strategy of demonstration, guidance, and "setting the prairie ablaze" form the "Spark" plan software. From a long-term concept, its output will have more profound effects than "Spark" technology, products, and other hardware outputs and even greater significance for developing nations. This is precisely one of the main reasons that the UN is supporting extension of the "Spark" Plan to Third World nations.

III. Problems That Exist in Internationalization of the "Spark" Plan

A. Low personnel quality

Overall, a lack of qualified cadres who understand foreign trade and understand special fields is a common problem in China's technology exports. For the "Spark" Plan, however, this problem is particularly acute. The fact that the quality of personnel is lower than the average level of similar cadres in China poses serious obstacles to the collection of information, marketing and competition, negotiating contacts, and all other links, which makes it hard to adapt to the need for internationalization of the "Spark" Plan.

B. Lack of organization

If we could suitably organize our extremely deficient personnel, we could compensate to a certain degree for the problems created by personnel shortages. However, in the 5 years that the "Spark" Plan has been implemented, although we have exported a few products and technologies for total foreign exchange earnings of \$2.354 billion, the conclusion of the transactions in these contracts basically was accomplished through direct negotiations by enterprises or local areas with foreign partners. At the national level, no ideas, programs, plans,

or policy measures for internationalization of the "Spark" Plan have taken shape. The result is that this type of work is still limited to scattered exports in a disorganized state in which everyone is fighting for themselves or even cutting the ground from underneath each other, which has weakened our already very weak forces. This type of situation is a serious impediment to internationalization of the "Spark" Plan.

3. Information does not flow, channels are impeded

International market information and marketing channels are an essential condition and foundation for formulating strategy and tactics to internationalize the "Spark" Plan. Market information that does not flow and impeded marketing channels, however, are from a certain perspective an inevitable result of the lack of organizational programs and qualified personnel. The current situation is that on the one hand we have a lack of organized collection and understanding of information on demand in rural S&T markets in foreign countries and on the other hand we have not comprehensively analyzed and utilized the scattered market information that we do have. The result is that there is no foundation for work to formulate strategies and tactics for internationalization of the "Spark" Plan and we have been unable to proceed.

4. A lack of encouragement measures

Analysis at an even more concrete level shows that the primary obstacles to internationalization of the "Spark" Plan also include the lack of an excellent supporting environment. Whether we are speaking of setting prices for "Spark" export products, retention of foreign exchange, taxation policies, application and approval measures, or other areas, there is a lack of attractive policies for enterprises in all of them, which has affected the enthusiasm of enterprises for "Spark" product and technology exports and they lack the support of enterprises, which are the units on which "Spark" projects mainly depend. Simply relying on the initiative of science and technology committees at all levels cannot internationalize the "Spark" Plan.

IV. Proposals and Measures

The above analysis leads me to feel that the "Spark" Plan has already entered the mature stage and that the preliminary conditions for internationalization exist, whether we are speaking of "Spark" products, technology, or equipment or of management and the external environment. We also have definite advantages in the areas of market prospects and appropriateness of the technology. Although there are problems like low quality of personnel, ineffective organization, inflexible international market information, a lack of effective encouragement measures, and so on, overall the time for internationalization of the "Spark" Plan is already mature. For this reason, I propose:

A. Establish organs, formulate programs

Highly effective organizations, effective cadres, realistic objectives, and feasible measures are the keys to the success or failure of internationalization of the "Spark" Plan. Thus, establishing special organs and formulating programs, plans, and measures are the primary tasks. Because the problems involved in internationalization of the "Spark" Plan touch upon a broad area and involve considerable difficulty, I suggest that we organize leadership groups led by the State Science and Technology Commission with participation by cooperative departments, rural departments, central "Spark" departments, industrial departments, achievements departments, and so on and that effective cadres who are familiar with technology export trade, "Spark" Plan management cadres, and market information and key marketing personnel be transferred to form a "Spark" Plan Internationalization Office. On the basis of conducting domestic and foreign survey research, we should formulate long-term programs and objectives and short-term foci, market strategies, key marketing tactics, regional market opening foci, and so on to make a comprehensive plan.

B. Do extensive survey research of international markets, establish marketing networks

Market information analysis is a decisive condition for formulating measures. Thus, the first task of the "Spark" Plan Internationalization Office is market survey research. As for concrete actions, the first thing is that we should give special attention to fostering the role of Science and Technology Offices in our foreign embassies and use the Science and Technology Offices in our embassies located in all countries, especially in the Asia-Pacific region and Third World countries, to collect information on the natural and geographical conditions of the countries where they are located as well as research conditions, economic development levels, the quality of rural labor power, traditional industry and rural development directions, and S&T market demand. Second, they should collect, summarize, and analyze the scattered relevant information from all departments and feedback information from the various international exhibitions and sales fairs where "Spark" technology and products have participated. Third, on the basis of these two items of analysis, we should decide upon key development regions and national markets to enable the focused extension of technology, products, and equipment and hold goal-based and focused "Spark" achievement exhibitions and sales fairs in the selected regions and countries to collect and verify additional market information and revise our programs and strategies.

After formulating market strategies, establishing marketing networks becomes a key issue. Because of our cultural isolation and our unfamiliarity with foreign economic and social conditions, it would be very hard to open up marketing channels by simply relying on our own forces. Thus, we can select reliable local marketing businesses in foreign countries and utilize local marketing networks. We should also pay attention to fostering the role of Chinese personnel who have studied

abroad, worked for long periods in foreign countries, or even reside in foreign countries and gradually establish our own marketing networks.

C. Adopt flexible and diversified output patterns

As for concrete methods for internationalization of the "Spark" Plan, we should try to diversify as much as possible. For example, we can use "Spark" product exports, technology transfers, and energy exports to open up international markets. We can work on contractual responsibility for "Spark" technology. There can be turn-key projects which export a full set of products, technology, equipment, and training. We can hold training classes and "Spark" technology and management training classes oriented toward the Third World. We can send out "Spark" S&T sowing teams like Taiwan's "farm cultivation teams" to work for long periods in foreign countries.

Adopt flexible and diversified arrangements to ship out "Spark" products, technology, equipment, and management methods, which will also create opportunities for S&T labor shipments.

D. Reinforce propaganda, expand the international influence of the "Spark" Plan

Increasing the understanding of the "Spark" Plan by international society and expanding the international influence of the "Spark" Plan are important ways to gain international assistance, especially financial assistance from the UN. Of course, this is also an important way to gain potential customers. In the area of concrete measures, I propose that we continue goal-oriented and focused holding of "Spark" technology and product international exhibitions and sales fairs. We should move as quickly as possible to hold an international discussion meeting on the "Spark" Plan. We should organize forces to compile works in Chinese and English that explain the "Spark" Plan.

In the 5 years that we have implemented the "Spark" Plan, we have developed several products, technologies, and equipment that have excellent market prospects. Many production models have appeared. In the area of theoretical research, the Policy Office in the Rural Department of the State Science and Technology Commission has organized and entrusted the State Science and Technology Commission's Research Center and other units to conduct a national sample survey. Analysis of the results of implementation and research on operational mechanisms have been completed, which provides the conditions for propaganda about the "Spark" Plan to foreign countries.

E. Create an international and domestic supporting environment to promote "internationalization of the 'Spark' Plan"

An excellent supporting environment is a guarantee for the successful internationalization of the "Spark" Plan. We should organize international conferences, hold

training classes, and make other arrangements to fight for financial assistance from the UN and other international organizations.

Inside China, the State Science and Technology Commission should lead the way in calling upon all relevant price, finance, planning, taxation, and foreign trade departments to provide specific preferential policies to improve matching measures.

Comrade Song Jian [1345 6943] has pointed out many times that the "Spark" Plan should be oriented toward the world and should publicly unfurl the "Spark" banner at the UN. Now, the time for concrete implementation of this goal has arrived and we should not waste time in formulating plan objectives and adopting truly feasible measures. There will be great potential for internationalizing the "Spark" Plan.

Direction of China's S&T System Reform in 1990's

91FE0559D Beijing BEIJING KEJI BAO [BEIJING SCIENCE AND TECHNOLOGY NEWS] in Chinese
16 Mar 91 p 1

[Article by reporter Hao Meifang [6787 2734 5364]: "National Conference of Science and Technology Commission Chairmen and Science and Technology Department Directors Decides on Goals for Reform of S&T System in Final Decade of This Century"]

[Text] At the recent National Conference of Science and Technology Commission Chairmen and Science and Technology Department Directors, decision makers from S&T departments in all of China's provinces, municipalities, autonomous regions, cities with province-level economic decision-making authority, and ministries carried out far-reaching discussions of S&T programs and reform of the S&T system during the Eighth 5-Year Plan and the next 10 years that further clarified the objectives and directions of reform of the S&T system over the next 10 years.

Those attending the conference felt that the last 10 years of this century is an extremely important decade in the process of China's socialist modernization and construction. For this reason, we must maintain stability and continuity in S&T work principles and policies and use continued intensification and perfection of reform work already undertaken in all areas as a basis for taking larger steps forward and establishing a new S&T system over the next 10 years. Resolutely adhere to the principles of "orientation [toward economic construction]" and "reliance [on S&T progress]", establish and develop a new system that conforms to the objective laws of S&T and economic development and mutually integrates and promotes S&T and the economy. Further perfect the three-level deployment of S&T work oriented toward the main battlefields of economic construction, development of high-tech research, high and new technology industry,

and basic research, reinforce unified planning, rationally deploy forces, and promote comprehensive development of China's S&T.

The conference felt that the state should continue to maintain crack and vital research forces to take on major state basic, comprehensive, and long-term scientific research tasks and fully foster the role of institutions of higher education. Social public welfare-type research organs should simplify as appropriate and achieve networking of structures and socialization of functions. The state and governments at all levels should continue to provide stable financial support for this work to maintain its sustained and stable development.

Many technology development-type scientific research organs should develop in the direction of integrating scientific research, production, and administration and continue to enter and grow in the economy, and use markets as a stage and economic development as their objective based on their own characteristics and concrete conditions with guidance and support from state policies and plans to fight for self-development in competition and find a position where they can play their role to the fullest. Some of them can enter enterprises or enterprise groups and become their technology development organs. Some can establish or absorb enterprises to serve as intermediate testing and production base areas and gradually develop into S&T-type enterprises or enterprise groups. Some can combine with design and production units to form complete technology project companies. Some can orient toward industry and become technology development centers for industry. Some can orient toward medium-sized and small enterprises and township and town enterprises and become regional or industrial technology development or extension service centers, and so on. When these organs implement their own managerial and administrative decision making, the state can provide policy guidance and provide the needed support in scientific research capital construction, updating and upgrading important equipment, and other areas.

With a prerequisite of adhering to the system of ownership by the whole people as the main factor, encourage and support the development of all types of civilian-run scientific research organs. Based on their own concrete conditions, some of these civilian-run scientific research organs are providing technology development services based on resources, some are working on high and new technology R&D and development of these industries, some are involved in various types of technical services. They are playing important roles at the different levels of S&T based on technology and economic market changes and demand and have become a beneficial supplement to an organic part of China's S&T activities.

Those at the conference felt that in this category of scientific research organs, regardless of whether or not they were established independently and regardless of their scale or ownership qualities, the state should select

several of the best ones to serve as national-level scientific research organs using their S&T levels and contributions to economic and social development as a standard and provide focused support. In addition, readjustments should be made as necessary by selecting the best and abandoning the worst based on the needs of national development and the development conditions of each of the organs.

Those at the conference felt that large-scale and comprehensive scientific research organs, especially those under the jurisdiction of all departments of the central government, should actively explore various forms of management and development models and gradually reinforce their vitality. That part of work which can lead to invigoration should move ahead first to gradually invigorate all of them. Some can concentrate and reorganize superior quality personnel and advanced equipment within their units and provide focused guarantees, and they can implement preferential support policies and new management methods to make them develop and grow rapidly. Several technology development-type scientific research organs and S&T-type enterprises can be selected for trying out a stockholding system. Basic and social public welfare-type scientific research organs with the proper conditions can try implementing a board of supervisors or board of directors leadership management system composed of unit leaders, mass representatives, representative of higher-level administrative departments, and scholarly authorities in society.

Those at the conference felt that national-level scientific research organs which have passed strict state examination and ratification should be provided with focused support and be vested with the right to be involved in international S&T cooperation and circulation and technical economics trade with foreign countries. Actively encourage scientific research organs with the proper conditions to go to foreign countries and outside China's borders for independent investment or joint investment to establish research institutes or companies, and actively attract organs or individuals in foreign countries or outside our borders to make independent investments or joint investments to establish scientific research organs in China.

Use establishment of these policies to gradually implement an appropriate degree of separation of the ownership rights and managerial and administrative rights of scientific research organs, expand the decision making rights of scientific research organs, and gradually achieve the socialization of scientific research organs.

Those at the conference felt that we should continue to adopt measures to solve the problems of irrational S&T personnel distributions and poor treatment of S&T personnel, and encourage and support scientific research organs and S&T personnel to use the income from their labor which contributes to S&T, economic, and social development to improve their own working conditions and living conditions.

Leaders at all levels must increase their understanding of S&T and pay attention to S&T work to gradually reach a proper level of understanding and work, and fully foster the role of experts and increase the levels of science and democracy in policies and administration.

Li Xu'e Examines China's S&T System Reform

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[Article by BEIJING KEJI BAO reporter Hao Meifang [6787 2734 5364]: "China's Achievements in Reform of the S&T System Attract World Attention, State Science and Technology Commission Deputy Chairman Li Xu'e Discusses S&T Operational Mechanisms and Patterns"]

[Text] At the recent National Conference of Science and Technology Commission Chairmen and Science and Technology Department Directors, State Science and Technology Commission deputy chairman Li Xu'e [2621 4872 6759] said that since the 3d Plenum of the 11th CPC Central Committee, and especially during the Seventh 5-Year Plan, China's S&T work has made achievements in the areas of reform and opening up and development that have attracted world attention and made enormous contributions to achieving our first strategic objective for development of our national economy. Profound historical changes have occurred in the mechanisms, patterns, and situations of S&T work. Practice has proven that China's principles and policies for reform of the S&T system and S&T development work are correct and successful.

Li Xu'e said that work to reform China's S&T system more or less began with the announcement of the "CPC Central Committee Decision on Reform of the S&T System" in March 1985. Based on the principles of "orientation [toward economic construction]" and "reliance [on S&T progress]", rather comprehensive reforms were carried out in China's S&T system in the three areas of operational mechanisms, organizational structure, and S&T personnel administration system. Implementation began with reform of the internal mechanisms and patterns in the S&T system and gradually intensified and spread into the broad realm of S&T progress in rural areas, enterprises, and society. In work methods, the focus was on reform of operational mechanisms which led to readjustments in organizational structures and reform of the S&T personnel management system. We implemented important measures to promote the conversion of S&T achievements into commodities and developed markets, implemented the "Technology Contract Law" and "Patent Law" and detailed principles, reformed the S&T allocation system and carried out management by categories for S&T work with different categories and characteristics, invigorated scientific research organs and relaxed S&T personnel administration policies, promoted the horizontal integration of S&T and the economy, promoted the entry and growth of S&T in the economy, and promoted S&T progress in

rural areas and enterprises and development of high and new technology industry, and so on. We implemented a science fund system, technology contract system, expenditure contractual responsibility system, institute director responsibility system, contractual administrative responsibility system, economic accounting system, bid solicitation system, hiring system and other management systems, and formulated several matching financial, banking, and taxation policies. At the same time, we gradually formed services with economic construction as the main battlefield, develop high-tech research, promoted the formation of high and new technology industry, affirmed a three-level configuration for sustained and stable development of basic research, and implemented the corresponding development plans.

Li Xu'e said that China's technology markets have grown from being non-existent to small and then to big and healthy and have now become an important part of socialist markets. Promoting the conversion of technical achievements into commodities and developing technology markets is a major theoretical and practical breakthrough in reform of China's S&T system as well as a major renewal of social concepts. Opening up and cultivating technology markets and establishing compensated transfers of technical achievements according to the law of value and in the form of contracts has played an enormous promoting role in research and development of S&T achievements and their application and extension. Technology in the form of commodities has permeated a broad range of economic and social realms through development, transfers, consulting, services, technical shares, technical and economic contractual responsibility, and other forms and generated enormous economic and social benefits and confirmed the status of converting technical achievements into commodities for all of society.

Li Xu'e said that like the conversion of technical achievements into commodities, reform of the S&T allocation system is the most important policy measure in reform of S&T operational mechanisms. Implementation of management by categories of S&T activities like basic research, technical development, social public welfare, and so according to their different qualities has gradually changed technology development-type organs and gradually oriented them toward economic construction. Social public welfare organs have tried to exploit their own potential, actively provided services to society, and earned income. Basic research organs have brought in competitive mechanisms. Over the past 5 years, motivated by the role of policy guidance and economic levers, scientific research organs have expanded their sources of tasks and opened up several funding channels like state financial, credit, and taxation policy preferences, enterprise and social inputs, creating their own income, utilizing foreign capital, and so on. Scientific research units have expanded their functions, improved their quality, greatly reinforced their vitality, and passed strict tests from the economic situation and gradually adapted to changes in operational mechanisms. Reform

of the S&T allocation system is gaining growing understanding and support on the S&T battlefield. In work to reduce allocations of professional fees for technology development-type organs, units under the central government may cease them entirely during 1991 and most local areas have basically done the same. A few local areas may complete this in 2 or 3 years.

Li Xu'e said that reform of S&T operational mechanisms has made scientific research organs decide to strengthen their consciousness of service to economic construction and self-consciously manage affairs according to economic laws. They are gradually changing their closed state of being purely oriented toward scientific research under the jurisdiction of government organs and operating independently outside of enterprises to readjusting their direction and expanding the scope of their tasks based on the needs of economic construction and S&T development and using various arrangements to enter the economic realm. Some have transferred technical achievements, some are developing toward integrated administration of scientific research and production, some have integrated with enterprises in a variety of levels and patterns, and some have gone into rural areas to undertake all sorts of technical and economic contractual responsibility activities and accelerated the transfer of S&T achievements toward production.

Because S&T personnel have implemented integration of technology, industry, and trade and integration of technology, agriculture, and trade by creating civilian-run scientific research organs not under ownership by the whole people in accordance with the principle of raising their own capital, voluntarily joining together, making their own management decisions, and assuming responsibility for their profits and losses, they are playing an increasingly obvious role in disseminating technology achievements, accelerating the conversion of technical achievements into commodities, and promoting the development of high and new technology industry to gradually form a situation in which the state, collectives, and individuals work together to develop S&T activities.

Li Xu'e said that reform of the S&T personnel administration system has led to a transition from the S&T personnel administration situation of one-time assignment for life, egalitarianism, and eating from the big common pot toward implementation of a recruiting system with definite circulation and competition mechanisms that is gradually developing toward scientific research, management, production, administration, and other areas and gradually reforming the irrational situation in the S&T personnel distribution and structure. Each year several 100,000 S&T personnel go to the front line in rural areas to engage in all sorts of technical and economic activities. There are several 100,000 more S&T personnel who use their free time to engage in second job activities with a prerequisite of completing the work for their own jobs and are promoting the circulation of intelligence and skilled personnel that is

playing an important role in promoting S&T progress in medium-sized and small enterprises and in township and town enterprises.

Li Xu'e said that S&T personnel are using their own labor to contribute to S&T and economic development. The importance and value of science and technology are gaining broader recognition in society every day, intellectual property rights are receiving the required protection, the social status of large numbers of S&T personnel is continually rising, social mechanisms which stimulate creativity and a social atmosphere of respect for knowledge and respect for skilled personnel are now taking shape, and the strategic status of S&T activities is now being affirmed. These profound changes will have a profound impact on the development of China's S&T, economy, and society.

Operational Mechanism To Promote S&T Progress Discussed

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[Article by Yang Lincun [2799 2651 2625] and Qiu Chengli [6726 2052 0448]: "A Discussion of Operational Mechanisms and Development Trends of S&T Progress in China"]

[Text] As reform of China's economic and S&T systems has continued to intensify, the issue of the operational mechanisms of S&T progress in China have attracted universal concern in S&T and economic circles. In the new situation of world S&T and economic development, finding ways to foster the advantages of integrating planning mechanisms with market mechanisms, accelerate the pace of technical progress in society, and gradually establish new S&T progress operational mechanisms in China based on China's economic and social development needs are a core issue in present and future reform of the S&T system.

I. Operational Mechanisms of S&T Progress Under the Planning System

Before the 3d Plenum of the 11th CPC Central Committee, China had implemented a planned economy. S&T progress activities were entirely a part of the planned economy and basically operated according to planned management mechanisms. The theoretical basis was: science and technology are part of the superstructure and should serve the economic foundation. The development of S&T work should be based on the needs of economic and social development, be included in state plans, and use financial allocations to support all types of research and development projects. Finally, scientific research achievements would be extended and utilized without compensation in all realms of the economy and people's lives to achieve the overall objective of using the fewest resources to gain optimum results, with S&T and other realms developing in a planned, proportional, and coordinated manner. To

achieve this ideal model, government S&T planning and management departments alone held the authority to employ administrative measures, make decisions on project establishment, allocate capital, assign personnel, and many other important matters to themselves. They used plans to assign scientific research projects to research organs and then used plans to develop, extend, and apply scientific research achievements in all realms of the national economy and people's lives. Thus, government departments were the center of decision making and the axis of operation. Scientific research organs and enterprises, on the other hand, were merely implementation organs under government jurisdiction and basically had no decision making authority.

Collecting experience over several decades, we now have a relatively profound understanding and many evaluations of S&T operational mechanisms under the planned economic system. The main characteristics are: 1) They can foster the advantages of planned coordination and can prevent redundancy and overcome decentralization to a definite extent. 2) They can establish relatively complete S&T research systems that provide the required guarantees for scientific research activities and enable research work to proceed normally, and they provide the required technical reserves. 3) They can centralize forces, focus on breakthroughs, and lead developments in certain incisive projects and thereby form S&T forces which surpass those of regular developing nations. 4) They can quickly solve several major S&T problems urgently needed by the national economy that are difficult and involve long schedules. Their main shortcomings are: 1) All of the departments which are concerned with the mechanisms, especially enterprises, lack the inherent need for technical progress and technical progress is slow. 2) The detachment of S&T progress from economic development is widespread and capabilities for turning S&T into forces of production are weak. 3) Because government administration departments have a unified hold over decision making, resource allocation, and other major authority, decision making bottlenecks are inevitable, which reduces work efficiency. 4) Plans cannot include everything and omissions are inevitable. This is particularly true for medium and small-scale application and extension projects which come in large numbers and cover broad areas, so they often are too busy attending to other things. The result is the interesting phenomenon of being able to launch satellites but unable to fix leaking commodes. 5) Because S&T progress is not very predictable, having to do everything through plans inevitably results in a loss of the accidental circumstances of S&T discoveries and inventions and their conversion into forces of production, whereas the history of S&T progress shows that these accidental circumstances play an extremely important role in S&T progress. This is one of the reasons why Silicon Valley appeared in the United States and not in the Soviet Union.

We can easily see that, first, the planned economic system cannot entirely overcome decentralization and

redundancy. Low efficiency due to overly concentrated authority always puzzles government administration departments, so there must be appropriate decentralization of authority as the amount of planning work grows. This gives local areas and departments a certain amount of planning and decision making authority, and when they are driven by their own interests and make investments in realms and projects which conform to their own interests, a certain amount of redundancy and decentralization are inevitable. Second, in the traditional planned economic system, the market economy has a very narrow space in which to exist. When a market economy exists, S&T progress operational mechanisms in pursuit of market commercial interests are also inevitable, although they are extremely weak. Third, because there is no true market competition to test the actual results of S&T progress, there is a softened tendency for S&T progress to be immature, unsystematic, and impractical.

Experience over 10 years of reform has shown that the reform overall has been correct and successful. This does not mean, however, that planning mechanisms have lost their positive role and vitality. In future intensification of reform, under conditions of coexisting planned and market economies, ways of dynamically and properly dealing with the integration of planning mechanisms and market mechanisms in S&T progress has become a key issue.

II. The Current Situation and Problems in China's Present S&T Progress Operational Mechanisms

Reform and opening up have brought many material changes to China's economic operational mechanisms and the regulatory role of market mechanisms in economic operation has been greatly enhanced. Statistics show that the number of directive plan products administered by the State Planning Commission has been reduced from 120-plus in 1984 to about 60 now and the proportion of China's gross industrial output value which they account for has fallen from about 40 percent to about 17 percent. Investments to implement directive plans account for only about one-third of total capital construction investments in units under ownership by the whole people. In the area of prices, the portion of the total amount of agricultural products sold by peasants for which the state set prices (including price increases) dropped from 67.5 percent in 1984 to about 20 percent in 1988. The proportion of the total volume of retail sales of consumer goods in society for which the state set prices dropped from 73.5 percent in 1984 to about 30 percent in 1988.

Changing economic operational mechanisms inevitably lead to changes in S&T progress operational mechanisms. This is especially true for technical progress operational mechanisms with direct links to the market, where qualitative changes have already occurred. At the micro level, besides completing scientific research plans and technical upgrading projects assigned by state plans, enterprises also raise their own capital to study and develop new technology and new products based on

market demand. While accepting vertical topics assigned by the state, scientific research organs and institutions of higher education also actively develop horizontal technology development and services oriented toward production and toward the market. All this technical research, development, and service work done outside of plans is for the purpose of making profits and is done according to market operational mechanisms. At the macro level, state projects to attack key S&T problems are more concerned with long-term economic and social benefits and with market demand. Something that is receiving attention is the fact that for the past several years the state has implemented several major S&T plans like the "Spark" Plan and "Torch" Plan which combine planning mechanisms with market mechanisms by using planning to guide the organization of vast numbers of scientific research personnel and use market mechanisms to send a wide variety of scientific research achievements into rural areas and enterprises. This method has been quite successful and created huge economic and social benefits. Successful implementation of the "Spark" Plan and "Torch" Plan have made very good attempts and provided beneficial enlightenment for our further discussion of integrating the planned economy with market regulation and gradually establishing new S&T progress operational mechanisms.

Market operational mechanisms now account for a substantial part of China's technical progress and are playing an increasingly important role. Still, this does not mean that market mechanisms have achieved the predominant status in S&T progress and that planning mechanisms have lost their proper role. Actually, planning mechanisms still hold a decisive status in technical progress. First, state investments are the main source of their capital. In 1988, the state allocated 6.984 billion yuan, or about 50 percent of the 13.927 billion yuan in total expenditures in China's scientific research organs. Income from professional fees accounted for 5.467 billion yuan or about 39 percent. Loans and other income accounted for 1.475 billion yuan or nearly 11 percent. Government allocations are mainly used for professional fees, special expenditures, S&T funds, and capital construction. The state accounts for an even larger proportion of R&D expenditures, over 90 percent. Second, state investments still dominate technical R&D in basic industries of the national economy. Attacks on key technical problems, survey and design, manufacture of equipment sets, and so on in agriculture, energy, communication, raw materials, and other industries must still depend mainly on state support because they require large inputs, have long schedules, and concern the overall situation. Third, many R&D projects which have disciplinary exploration and technical reserve qualities that are very difficult and involve long schedules also must still be supported by the state. These projects have no apparent market prospects and enterprises and research organs are unable to assume responsibility for investment in these types of projects. Although the role of market mechanisms has grown substantially over the past several years, they are relatively weak in the area of

technical research. Market mechanisms are embodied in a concentrated way in the rapid development of laboratory achievements into products or the utilization of existing achievements to develop technical services that earn profits in the market. Moreover, most of these existing achievements were formed by the state first investing finances and spending several years on research and attacks on key problems.

In summary, technical progress in China has now taken on a segmented configuration in which planning mechanisms and market mechanisms coexist. State planning mechanisms provide the main support for important projects and preparatory technical research while enterprises, research organs, and civilian scientific research organs rely mainly on market mechanisms to develop technology and place it on the market in the form of commodities.

The causes for this configuration are multifaceted, but the basic reason is that China's economic system is in a state of combining plan regulation and market mechanisms that is manifested as a situation in which two types of mechanisms inevitably coexist in relation to the question of technical progress. Different levels and different fields of science and technology select their own operational mechanisms based on how close they are to markets. At present, the reason is that China's market economy is just beginning and is still very immature and very imperfect, so it has only a limited pulling role in technical progress. Market mechanisms still cannot play a guiding role in China's technical progress. In another area, enterprises and scientific research organs at present still have not achieved a group organizational structure and attained the required administrative scale. Thus, enterprises do not have the technical capabilities to single-handedly complete projects to attack key problems, nor do they have adequate economic strengths to assume the risk that arises from investment in technology development. Enterprises will be unable to become the main force in technical progress for some time into the future, so the state's large and medium-sized industrial research organs will continue to play an important role.

Whether one is speaking of the external macroeconomic and social environment of technical progress or the conditions and capabilities of technical progress itself, all determine that planning mechanisms will continue to play a proper role for several years into the future. In other words, concerning the issue of technical progress, the situation in which planning mechanisms and market mechanisms coexist will continue to exist during the 1990's and for an even longer period of time. The question of how to take advantage of each type of mechanism and avoid their bad points so as to integrate the two well and readjust the proportional relationship between the two of them as needed is a basic issue in our formulation of S&T policies for the 1990's.

III. Dealing Correctly With the Relationship Between Planning Mechanisms and Market Mechanisms Is the Core Issue in S&T Progress Operational Mechanisms

Practice has proven that although pure scientific research has rather powerful superstructure qualities, S&T overall are modern forces of production and belong to the economic foundation. S&T progress does have its own operational laws and characteristics, but its operational mechanisms are basically economic operational mechanisms and they change as economic operational mechanisms change. In conditions of a planned economy, S&T progress basically conforms to planning operational mechanisms. In conditions of a market economy, S&T progress mainly involves market mechanisms. As reform of the economic system and reform of the S&T system gradually push forward, a development trend which integrates the planned economy with market regulation has appeared in China's economic operational mechanisms. The corresponding S&T progress operational mechanisms have also evolved from the singular planning mechanisms of the past into mechanisms in which planning mechanisms and market mechanisms coexist and this evolution will continue for quite some time to come. This requires us to have a clear understanding of the operational mechanisms at different levels of S&T progress, to understand the different roles and laws of these two types of mechanisms in S&T progress and take advantage of each, and to deal correctly with the relationship between the two. This should be the basic starting point to guide future S&T work and formulation of S&T policies.

Still, attaining the objectives outlined above will be very difficult. The reason is that the degree of closeness in the relationship between the different levels of S&T work (basic research, applied research, experimental development, etc.) and economic life varies, so there are also differences in the operational mechanisms to adopt. Moreover, there are several qualitative differences between planning mechanisms and market mechanisms and they are sometimes fundamentally opposed and mutually exclusive. For example, in S&T progress work, the objective of the former is to complete plans while that of the latter is to make a profit. Inputs for the former depend on non-compensated state allocations while the latter must raise their own capital or obtain bank loans. The achievements of the former belong to the state and can be utilized without compensation while the achievements of the latter belong to investors and must be utilized or transferred with compensation. Personnel in the former are assigned by the state while circulation is freely organized in the latter, and so on. An even bigger problem is that the economic mechanisms which integrate the planned economy with the commodity economy provide an objective environment in which both types of operational mechanisms coexist over long periods to be able to do technical R&D work that generates direct economic benefits, so it is very easy for major differences to appear concerning the selection of technical progress mechanisms. Thus, if we wish to establish new S&T progress operational mechanisms in

China, we certainly cannot simply borrow from experiences in foreign countries. We must base ourselves on China's national conditions and use respect for history and prediction of the future as a foundation for selecting China's S&T progress operational mechanisms.

IV. Some Ideas on Establishing New S&T Progress Operational Mechanisms in China

Since the beginning of the 1980's, as high technology has become more rapidly and widely utilized in production and world economic competition has become more intense, many developed nations which have implemented market operational mechanisms have formulated a variety of high-tech development plans to strengthen government intervention and management and provide the required funding support for concentrating forces to compete in world high-tech product markets. This offers much food for thought. Therefore, there must be careful analysis of the characteristics of the S&T progress operational mechanisms that have taken shape in China now. It can be expected that the role of market mechanisms in S&T progress will continue to expand and tend to increase. At the same time, state plans will also be continually perfected to meet the needs of the planned commodity economy. Overall, market mechanisms and planning mechanisms will be mutually coordinated and each will have their slants, but interlocking contradictions may appear and finding ways to link the two together properly is an important future task. To deal with these issues, we should further intensify reform of the S&T system and gradually establish new S&T progress operational mechanisms that meet China's needs.

1. Clarify the characteristics of different levels of S&T work, adopt different operational mechanisms according to their status in economic and social development, especially their relationship with market demand. Basic research and applied research as well as social public welfare-type scientific research (on the environment, standards, measurement, climate, etc.) usually do not generate direct economic benefits and basically cannot adopt market mechanisms. Instead, they must depend mainly on planning mechanisms. The state provides stable support by establishing organs, financial allocations, and other measures. However, appropriate competitive mechanisms must be brought into personnel circulation, capital, allocation, project establishment, and other areas to increase their efficiency. Technical research, development, utilization, and other work related to technical progress, however, should use operational mechanisms that organically integrate planning and market mechanisms with a slant toward each depending on actual circumstances and mutual coordination.

2. We should fully understand that both planning and market mechanisms will coexist for a long time in technical progress and deal properly with the relationship between the two. In principle, planning mechanisms should be the main force in long-term and important

technical research to attack key problems, equipment development, and technical progress in basic industry. Market mechanisms should be the primary force in technical development with a direct relationship to the market, especially consumer goods. We cannot combine an emphasis on market mechanisms with relaxation or elimination of state investments in technical R&D because current markets are incapable of pulling along all technical progress questions. On the other hand, if we neglect the role of markets, it will be impossible to convert large numbers of achievements into forces of production and we will repeat the mistakes we made prior to reform.

3. Resolutely promote reform, gradually expand the proportion of market mechanisms. During 10 years of reform, market mechanisms have come to play a growing role in technical progress work, but actually they are just beginning and will still require assistance and support. We should do good work in these areas: 1) Accelerate cultivation of a socialist commodity economy, create a situation of fair and reasonable competition, increase motive forces in enterprises for technical progress. 2) Continue gradual expansion of the decision making rights of enterprises, enable them to make their own technical R&D decisions. 3) Raise levels of rationality in the organizational structure of enterprises, actively support enterprise groups that integrate scientific research, production, and marketing. 4) Open up multiple capital source channels, help enterprises and research organs solve their capital problems.

4. Reform and perfect the S&T planning system, adapt it to development of the planned commodity economy. While working for more perfect directive plans, we should broaden the content of guidance plans and in particular be concerned with including development and conversion of scientific research achievements in state plans to guide support from all of society. Establish different capital channels according to different S&T research and development plans. Change the single channel of financial allocations and include social capital raising, loans, and other capital sources in state plans. At the same time, implementation of state S&T plans should absorb open bidding, competition, and other market mechanism methods.

5. Deal properly with the links between planning mechanisms and market mechanisms. At present, the state uses two-stage technical progress operational mechanisms in which planning mechanisms are used to do research while enterprises and research organs use market mechanisms to do development, and this sort of arrangement can be expected to continue through the 1990's. This arrangement conceals an extremely serious problem, which is the question of transferring intellectual property rights. Now, this sort of transfer mainly involves the state transferring them to enterprises, units, or individuals. Because we emphasize the conversion of S&T achievements as quickly as possible into forces of production, we have actually adopted rather ambiguous methods for transferring intellectual property rights. As

transfers of intellectual property rights increase and property rights are gradually demarcated more clearly, there will be a growing number of problems with this type of transfer regarding clear jurisdiction over property rights, conflicts of interests, and so on which will eventually affect technical progress in society. We must explore ways to solve this problem as soon as possible.

6. Pay attention to technical innovation, establish new S&T progress operational mechanisms in which technical innovation is the central line. Overall, China's S&T strengths are no weaker than those of many emerging industrial nations, so why are our enterprise technical levels backward compared to those in the "four mini-dragons" of Asia? One of the main reasons is that we have not yet been able to establish technical innovation mechanisms. The state should formulate plans, readjust policies, and use other measures to create an objective environment that is conducive to technical innovation in all of society. Enterprises should focus on technical innovation, and gradually establish operational mechanisms extending from technical research and development to production, marketing, services, and the eventual cornering of markets.

Establishing an Objective Responsibility System

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[Article by Gu Longyuan [7357 7893 3293] of the No 625 Institute, Ministry of Aerospace Industry: "A 'Five Guarantees and One Link' Objective Responsibility System Model Centered on Assessment of 'Spiritual and Material Civilization'"]

[Text] [Abstract]

This article describes the main characteristics and basic methods used in an objective responsibility system in the No 625 Institute of the Ministry of Aerospace Industry that is based on assessment of the "five guarantees and one link" and the main results achieved. It also describes an objective responsibility system centered on assessment of the "two kinds of civilization".

Since the No 625 Institute in the Ministry of Aerospace Industry began trial implementation of a comprehensive technical and economic contractual responsibility system in 1986, we have carried out continual exploration and perfection over the past 4 years and made several rather substantial revisions in its internal contractual responsibility system. It began trial implementation of an objective contractual responsibility system in 1988 that was centered on assessment of the "five guarantees and one link". The core of this method was establishing a system for assessment of construction of the two types of civilization for close integration of economic benefits with scientific research achievement levels and long-term development. By using reinforced management and quantitative indices for assessment, stronger economic accounting, perfection of allocation

methods, and other measures, it gave prominence to scientific research levels, quality, benefits, and reserve strengths. It increased the institute's economic benefits and social benefits and promoted the achievement of technical economics goals in the entire institute.

Trial implementation over the past 2 years has revealed in a preliminary fashion clear goals, high policy transparency, substantial encouragement role, and characteristics of resolutely focusing on both types of civilization for the "five guarantees and one link". It has further promoted initiative, provided a rather good solution to the shock of "second after-hours jobs" and "retention of private aspects". It has fostered the institute's advantages in integrating technology used for both military and civilian purposes and created a new situation to integrating military and civilian industries. It has caused the institute to complete an initial transition from scientific research solely for the military industry into an scientific research administration institute that integrates military and civilian aspects, and it has increased our self-existence capabilities and worked as a motive force in service to national economic construction. There were obvious achievements in the military products scientific research topics we completed in 1988 in the level and number of achievements, civilian product administration and development, social and economic benefits, and other areas.

I. The Main Characteristics and Basic Methods of the "Five Guarantees and One Link"

The "five guarantees" refer to guaranteeing directive tasks, guaranteeing S&T quality levels, guaranteeing net income (profit objectives), guaranteeing contract fulfillment rates, and guaranteeing scientific research reserve strengths. The "one link" is the link between the income allocated to contractual responsibility units and employees and their completion of "five guarantees" indices and construction of spiritual civilization.

Based on the tasks, qualities, and characteristics of the contractual responsibility units within the institute, it was divided into four types of contractual responsibility accounting units: basic research offices, basic workshops, service offices, and auxiliary workshops. Distinctions were made in the actual content and requirements of the "five guarantees" for each type of unit.

For basic research offices, guaranteeing directive tasks refers to guaranteeing the vertical contract tasks assigned by the state and ministries, state projects to attack key problems, high technology, and key development or contractual tasks assigned by the institute. Usually, tasks awarded by horizontal contracts that amount to less than 100,000 yuan are kept on file at the institute after research offices sign direct contracts with outside parties and the institute inspects the contract fulfillment rate.

Guaranteed S&T quality level indices refer to guarantees of the number and levels of scientific research achievements completed each year. They are submitted to the ministry level for examination and acceptance as

achievement projects and receive achievement project numbers and grades at the ministry level and above. Projects which take more than 1 year establish assessment points and make assessments on the basis of the requirements and quality stipulated in the scientific research work procedures.

Guaranteeing S&T reserve strengths refers to increases in the added value of technical reserves in research offices, scientific research and production equipment and instruments in units with contractual responsibility, technical upgrading, and other fixed assets and improvements in the quality of personnel. Units with contractual responsibility are encouraged to make long-term considerations, rationally utilize scientific research funds and development funds, gradually add advanced scientific research experiment and production equipment and instruments over the years, improve scientific research and production conditions, and invest in knowledge, maintain S&T reserve strengths, and avoid short term behavior.

Guaranteeing net income indices refers to assigning annual net income indices based on scientific research, production, and technical strengths of each contractual responsibility unit. Moreover, these indices are divided into "three grades and four levels" profit objectives, with rewards being provided on the basis of the levels and grades of actual profits according to different proportions as stipulated.

Net income indices are used as the basis for assessing each of the indices and assessment allocations are made on the basis of two 100 percent figures for material civilization and spiritual civilization, and multiplying these two figures to get the amount actually allocated to the unit with contractual responsibility.

Because the "five guarantees and one link" were intensified and perfected on the basis of the original contractual responsibility program, they have the advantages of the original program as well as their own characteristics.

A. Focus on aviation as the core, correctly deal with the relationship between military and civilian tasks:

As a national defense scientific research unit, we must be clear that our main task is to serve modernized construction of national defense and clarify that our duty is to provide as many advanced level scientific research achievements, advanced technologies, and new products as possible for the aerospace industry, clarify that our primary objective is to create benefits for society and not just economic benefits for ourselves, and make it clear that implementation of "guaranteeing military tasks, shifting to civilian tasks" is the focus of our work at the present time. Thus, adhering to aerospace as the core, "guaranteeing military tasks and shifting to civilian tasks", and establishing a new system that integrates military and civilian production are the overall goals in implementation of the objective contractual responsibility system.

The "five guarantees and one link" give special emphasis to guaranteeing directive tasks, clarifying the number and levels of achievements examined and accepted, and directly linking achievement awards at the ministry level and above to allocations to units. The first goal is guaranteeing that key specialized scientific research and technology can develop and holding more high-level scientific research achievements in reserve. The second is to do good planning and formulate good 5-year development plans for several levels including preliminary research, attacks on key problems, model development, high-tech tasks, civilian product development and trial production, and so on to ensure that preferential arrangements are made for state attacks on key problems, ministry preliminary research models, and high-tech tasks, and give prominence to the key development specializations of the institute. The third is to reinforce S&T management, respect the laws of S&T development, rigorously seek truth, and implement scientific research quality controls according to the implementation of effective scientific research management procedures and quality control regulations to guarantee quality and reputations. The fourth is to be concerned with correct administrative guiding ideologies and do good technology market surveys and forecasting work to make full use of the institute's comprehensive technical advantages and integrate the long and short terms for comprehensive development.

Give full expression to concern for and preference for military product scientific research when implementing management and formulating policies.

1. On the basis of development plans formulated by the National Defense Science and Engineering Commission and the Ministry of Aerospace Industry, readjust and establish key specializations and key scientific research staffs engaged in preliminary research. Set aside some capital from the income earned from civilian products within the institute as a whole each year to support key specializations: computer-aided design and manufacturing, composite materials, numerical control processing, flexible manufacturing, non-destructive testing, aviation models and tools, and so on, and assume responsibility for purchasing the equipment and instruments needed for preliminary research topics and improving scientific research conditions. For example, build a new 3200M2 computer plant building and rebuild the composite materials laboratory and air-conditioned clean building, import numerical control CO₂ laser equipment, retain two 3 and 5-coordinate numerical control milling machines, and so on.

2. Guarantee scientific research funds for preliminary research and model tasks. Reinforce management measures, do not allow civilian product tasks to be squeezed out, and provide appropriate subsidies to accelerate the pace and quality of project completion.

3. Military product projects that are assigned as directive tasks can receive preferential guarantees of materials, power equipment, processing and trial manufacture,

inspection measures, and reserve strength services. Use administration, plan inspection management, and economic measures to ensure the completion of military product scientific research tasks taken on by the institute.

4. Adopt active measures to improve the treatment of personnel involved in military product projects:

1) Collect 20 percent of testing and experiment funds and have the institute subsidize the remainder. This means reducing scientific research costs and improving the quality of scientific research to give project groups higher percentage deductions and bonuses;

2) Openly adopt preferential treatment in job title appraisals and hiring for S&T personnel who have made outstanding achievements in their involvement in military product project work over the years;

3) Besides normal deductions and rewards for the "five guarantees and one link", reward task completion for several model tasks assigned by systems engineering and do not tax bonuses. Up to the end of 1988, the average rewards for units in the institute involved in military product scientific research have consistently been higher than those of units involved in civilian product development tasks.

With a prerequisite of guaranteeing completion of preliminary research, models, and other military product scientific research tasks, give full play to the institute's comprehensive advantages, shift about 60 percent of its forces into civilian product development and service to national economic construction, and focus economic work on increasing technical economics benefits. Use civilian product development and an appropriate amount of trial production to open up sources of economic income for the institute and obtain support, provide capital guarantees for scientific research work, improve scientific research and living conditions, and gradually increase the economic incomes of employees over the years. Use this to increase the institute's condensing force, make reform and contractual responsibility work in our institute develop smoothly toward even higher levels.

B. Establish an index assessment system for construction of the two types of civilization

Establishing quantitative indices and an effect assessment system are prerequisites and fundamental aspects in implementation of the objective responsibility system.

The first problem our institute encountered when it implemented internal contractual responsibility was determination of contractual responsibility indices. They had to be clear and concrete and be capable of quantitative assessment, and they had to conform fully to reality and have an appropriate degree of high and low levels. Thus, they had to be advanced to make contractual responsibility units feel pressure, and they had to permit quotas to be achieved with a suitable degree of

effort. The indices had to play a stimulating role and establish confidence that tasks could be completed. The first among them were economic indices because net income was one of the core aspects for assessment in our implementation of management by objectives.

Quantitative methods for formulation of economic indices: We used the institute's objectives for economic income from all areas that should be earned during 1990, including scientific research professional funds, as the foundation and used the actual amount completed during 1989 as the starting point to calculate a yearly rate of increase and total internal profits that should be achieved during each year. Next we used the number of people involved in contractual responsibility, total wages, equivalent value of fixed assets, and amount of building space available to embody the capabilities and strengths of each unit as the four items for making calculations, separated out yearly economic (profit) indices according to different allocation rates, and adopted a profit objective contractual responsibility principle of "ensuring base figures, guaranteeing amounts turned over to higher authorities, keeping a greater portion of over-quota income, and self-compensation for income shortages" to carefully divide and quantify the yearly profit indices of each unit into "three levels and four grades" profit objectives.

The first level was responsibility and obligation goals, called "base figure profit goals to be turned over to higher authorities" (A). The second level was the work objectives of employees, called "contractual responsibility base figure profit goals" (B) = 2.5(A). The third level was over-quota goals, which were divided into two grades: "grade-one prospective goals" (CI) = 3.75(A) and "grade-two prospective goals (CII) = 5(A).

The proportional relationships among each of the levels and grades were fixed for 3-year periods, while revisions were made in the yearly increase rates of the profit objective base figures (A) for each unit on the basis of changing natural conditions in the units. This method of allocating contractual responsibility indices on the basis of actual capabilities basically eliminated the phenomena of "whipping running oxen" and protecting backwardness and made each unit assume economic obligations under equal conditions.

The assessment system used for the "five guarantees and one link" objective responsibility system was the system used to assess the two types of civilization. Practice has proven the effectiveness of making comprehensive assessments by resolutely applying construction of the two types of civilization. Employee ideology throughout the entire institute was relatively stable in 1988 and the political situation of stability and unity was further consolidated and developed. No major criminal cases or political accidents occurred and it passed a finance and tax audit at the end of 1988.

Using the two types of civilization can restrict the possible appearance of simplistic economic concepts and

shorter term behavior in contractual responsibility units and encourage everyone to complete their work and deal better with the relationship between their jobs and second after-hours jobs. It can ensure that the direction of reform and contractual responsibility is correct.

The concrete methods used to assess the two types of civilization were:

1. The content of "five guarantees" and other projects formed the primary content of assessments of construction of material civilization. A percentage system was used to establish "standard points" for each item in formulating careful principles for inspection and evaluation and the conditions for increasing or reducing points. Quarterly and annual inspections and evaluations were made to derive the material civilization construction assessment coefficients (K1) for the units.

2. Observance of discipline and the law, working styles, and other items comprised the content of spiritual civilization construction assessment for work in leading organs, party, government, and labor groups. Like material civilization, quarterly and annual inspections and evaluations were made to derive spiritual civilization construction assessment coefficients (K2).

3. Assessment groups were composed of administrative leaders and leaders in CPC committee organs and professional departments in primary organs. They were responsible for preparing summaries and statistics following the inspections and evaluations and submitting them to the institute director after verification for implementation after examination and approval.

4. The actual allocations made to units = total allocations according to the proportions of each grade $X K1 X K2$.

C. Implementing accounting and centralized financial management which ties together all forms of economic income

Economic accounting was the basis for assessing the situation in each contractual responsibility unit in regard to completion of economic indices. Thus, perfecting economic accounting and cost management were the foundation for implementation of the objective responsibility system.

To do good reform of contractual responsibility work, the institute had to overcome problems related to complex accounting targets, many variable factors, and so on. On the basis of the characteristics of each unit, they formulated matching internal price systems and cost management accounting methods and established internal banking and transfer account fee collection system along with financial management systems. This gradually standardized and systematized economic accounting work and established excellent economic procedures and unified regulations within the institute which ensured that work to reform contractual responsibility went smoothly.

1. We established a "dual-level accounting, triple-level management" cost management and accounting administrative system for the institute and contractual responsibility units. This involved dual-level accounting between the institute and research offices and workshops, and a triple-level management system for the institute, offices (workshops), and project groups (teams and groups). The contractual responsibility units set up special accounting personnel that prepared a "monthly report accounting table" with unified headings, unified methods, unified procedures, and unified schedules according to written stipulations. This reinforced basic work on accounting data and encouraged the units, project groups, and S&T personnel to be concerned with cost outlays and accounting work.

2. Accounting and allocation methods that tied together all types of economic income were adopted. This tied together all the expenditures and income generated from scientific research, production, and management activities for each accounting unit including vertical and horizontal tasks, technical consulting, external cooperative production, joint administration, and so on for accounting. Bonuses and development funds were allocated according to the stipulated proportions for the yearly net income of units. The units carried out cost accounting management internally for each project group.

3. Fixed asset depreciation were implemented. Depreciation was done for yearly utilization time on the basis of 20 percent, 50 percent, and 100 production of the original value and 2 percent of the 4 percent income depreciation fund (actually a utilization fund) based on the depreciation was returned to the units to serve as depreciation capital for adding replacement equipment, instruments, and so on.

4. Incomplete cost accounting was adopted for institute administrative funds. Part was shared out into unit costs and the remaining large portion was allocated a second time in a unified way by the institute. Contractual responsibility units were responsible for 95 yuan/person in 1988 and 100 yuan/person in 1989.

5. It was stipulated that no contractual responsibility units could establish their own social bank accounts. Transfer accounts, income and outlays, and settling of accounts were implemented through "internal banking" and financial administration for all internal and external economic contacts. This helped in capital raising, centralized utilization, and management, and it improved capital utilization performance, which aided in understanding the economic situation in units and avoiding a "loss of control" in the institute's internal economy.

The accounting method of tying things together encouraged unit leaders and employees to be concerned with collective benefits and the overall economic situation. Linking accounting with bonuses strengthened the concept of economics, benefits, and responsibility. It promoted a universal concern for the applicability and

economy of projects and products, conscious exploitation of potential and "double increase and double economy" [increase production and practice economy, increase income and reduce expenses], establishing a consciousness of quality and a concept of market competition, and striving to accelerate increased output with fewer inputs. Making units an accounting entity and tying all categories of income together to calculate units' net income and compute the payment of bonuses can prevent the creation of cost transfers due to differences in the proportions of deductions and rewards for different types of tasks as was done in the past and ensure the authenticity of scientific research expenditures in using special funds for special purposes and cost accounting. It also can deal with phenomena like "picking the fat or choosing the lean" [choosing whichever is to one's personal advantage], "uneven hardships and happiness", and so on and solve problems like an unwillingness to work on military product projects because of a shortage of bonuses for military product tasks, and so on. This attained the objectives of "using civilian products to support military products" and "using civilian products to guarantee military products" and stabilized military product scientific research staffs.

D. Adhere to the principle of linking allocations closely to technical economics benefits

One goal in implementation of the objective responsibility system was to destroy the "iron rice bowl" in allocations and motivate employee initiative. Thus, resolutely linking allocations with benefits is the key to implementing an objective responsibility system.

The deduction and reward method used in the "five guarantees and one link" gave prominence to the responsibilities, rights, and interests of contractual responsibility units, took into consideration the interests of the state, collectives, and individuals, and embodied the benefit allocation principle of higher base number profit indices completed for greater risks and contributions and higher proportions of deductions and "standards attainment prizes". This type of allocation policy was used to guide units in legally organizing good management of arrangements for second after-hours jobs and income allocation problems.

1. For completion of grade (A) profits, each person was only given a 120 yuan "base bonus" and 120 distant-suburbs work subsidy. When they were not completed, besides not issuing "base bonuses" and "suburb subsidies", no more than 30 percent of total wages in the unit were deducted according to the rate at which completion was not achieved.

2. When profits above grade (B) were completed and after taxes are paid, allocations are divided 6:4 or 7:3. Stipulations call for dividing 50 percent as bonuses and living expenses and 50 percent as a unit development fund. "Standards attainment prizes" were also established. When completed higher than grade (B), currently

employed leading cadres in the units are issued "standards attainment prizes" higher than the employee portions.

3. Appropriate readjustments were made in bonus tax requisition standards within the institute to fully exploit the role of positive aspects of the bonus tax and encourage initiative to create more benefits.

4. The formula used to calculate annual bonuses and development funds in contractual responsibility units is:

Actual total bonuses achieved in unit = (total available bonuses for allocation X K1 X K2) - Total amount of bonus taxes to be paid + total "base bonuses" + total "standards attainment prizes"

Actual unit development fund = (total available development funds X K1 X K2) - total unit "standards attainment prizes"

5. Units made their own decisions regarding the methods used to allocate bonuses within units and formulated "detailed principles for assessing reward methods". Although there were some differences due to different conditions, all the allocation principles were linked to individuals' job duties, attitudes toward labor, spiritual civilization, and labor achievements and benefits.

6. The reward method used in organs of the institute as a whole involved implementation of job post reward coefficients and secondary allocations were made after assessing department leaders. Average rewards for personnel in organs of the institute as a whole were controlled at 0.77 of the average bonuses for contractual responsibility units. Bonuses for second-line personnel in contractual responsibility units were awarded in consideration of the job post reward coefficients of the organs to motivate initiative on the grassroots first line and normal circulation of personnel within the institute.

II. Main Achievements in Trial Implementation of the "Five Guarantees and One Link"

A. They have promoted the development of military industry scientific research and civilian product development work:

1. In 1988, we completed 100 percent of aviation preliminary research projects to be completed during that year and the completion rate for inspection points for multi-year projects was 98.8 percent. Management and utilization of scientific research expenditures received good evaluations from the National Defense Science and Engineering Commission, the Ministry of Aerospace Industry, and academies.

2. We received 12 scientific research achievement rewards from the ministry and higher levels in 1988. These included a second-place state S&T progress award for the strength 5 composite material vertical tail project, and the other projects also attained advanced levels in China and foreign countries and made a contribution to the cause of aviation science research. Twelve new achievements passed ministry-level inspection and acceptance, and six of them were also given "Spring Swallow Awards".

3. Excellent social benefits were obtained in civilian product development. After several years of efforts, civilian product development has now concentrated on energy resources, communications, pharmaceutical and medical treatment equipment, food product machinery, construction machinery, models, special purpose integrated precision machine tools, and other fields. We provided over 200 sets of special purpose equipment and instruments to enterprises in and outside of the ministry in 1988, most of them import replacement products. We effectively supported technical upgrading in enterprises and saved the state over \$4 million in foreign exchange. Advances in civilian product development increased the extent of industrialization of scientific research achievements in our institute from 20 percent in 1985 to about 80 percent in 1988.

2. There have been rather obvious increases in economic benefits (see Table 1).

Economic Benefits in 1988

Number	Project name	Total	Compared to 1985
1	Institute gross income	Over 20 million yuan	The economic gross income goal proposed in 1986 and completed 2 years ahead of schedule was 3 times the amount in 1985
2	Volume of horizontal sales	Over 10 million yuan	2.7 times the 1985 figure
3	Taxes paid to the state	Over 670,000 yuan	2.5 times the 1985 figure
4	Pre-tax income	Over 4 million yuan	A more than 1.7-fold increase over 1985

After overcoming the severe effects of the disturbances in Beijing in the spring and summer, capital shortages, slumping markets, and other problems in 1989, we still completed 100 percent of the year's projects and 14 scientific research achievements received ministry-level

and higher awards. Sustained and stable development was achieved in civilian product development, our economic income held steady at the 1988 level, and there was a slight increase in the number of horizontal contracts signed.

III. Reform of Contractual Responsibility Requires Continual Intensification and Perfection

Like other contractual responsibility methods, the "five guarantees and one link" requires additional practice and perfection to foster the greatest possible positive effects on manpower, systems, and management and do good work to reform the S&T system.

The present social environment places substantial pressures on research institutes under the ministry and our reform tasks are relatively arduous. Reform has now reached a crucial instant. There is both hope and problems, opportunities as well as difficulties. For the institute itself, we should face the characteristics and requirements of research institute reform work and explore "three-level" intensive reform. The first level is reform in the area of allocation to motivate people's initiative, increase efficiency and benefits, and stabilize staffs. The second level is to orient management toward results, exploit "hidden" management potential, and increase development capabilities, strengths, and reserve strengths. The third level is to orient S&T toward results, make contributions to S&T progress and national economic construction, cause S&T to truly enter the economy, and foster the role and status of research institutes in social progress.

State Science and Technology Commission Promulgates Arbitration Regulations for Technology Contracting

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[Text]

Chapter I. General Principles

Article 1. To guarantee a mechanism for arbitration in technical contracting (hereafter referred to as "arbitration mechanism"), to process contract disputes correctly, and raise the efficiency and quality of the handling of cases to protect the rights and interests of contracting parties, this regulation was formulated in accordance with stipulation of article 20 of the (Temporary Regulations for Administration of Arbitration Mechanism for Technical Contract Arbitration).

Article 2. This regulation is applicable to the following actions taken in accordance with the arbitration formulae of the arbitration mechanism approved and established by the State S&T Commission.

(1) Handling technical contract disputes.

(2) Handling disputes arising from associations of rights and duties of technical consultation and technical services, transfer of technology, and development of technology in other types of contracts.

(3) Deciding alterations and cancellations of technical contracts in accordance with Article 29 of the rules implemented by the Technical Contracts Law.

Article 3. Arbitration rights exercised by law in the arbitration mechanism in independently developed business activity are not subject to interference by any organization, unit, or individual.

The arbitration mechanism should, through its actions, instruct the contracting parties to be mindful of compliance with laws, regulations, and policies, and fully carry out obligations of technical contracts.

Article 4. In processing technical contract disputes through the arbitration mechanism, arbitrations should proceed in accordance with the facts, the rule of law, and in accordance with principles of furthering the good of science and technology.

Article 5. The arbitration mechanism should handle cases with impartiality, guarantee and facilitate all the rights of litigants exercising arbitration actions, and apply the law equitably and uniformly to all litigants.

Article 6. In handling of technical contract disputes through the arbitration mechanism, mediation should be done voluntarily and legally, and if mediation is not achieved, the dispute should be promptly adjudicated.

Article 7. The handling of technical contract disputes should be done through joint consultation, and with a single adjudication.

Article 8. The State S&T Commission has set up a Technical Contract Arbitration Committee to administer the national arbitration mechanism and guide arbitration actions.

Chapter II. Acceptance and Hearing

Article 9. The acceptance and hearing of technical contract disputes through the arbitration mechanism should be done with arbitration provisions specified in the contract, or a written arbitration agreement reached after contract. The arbitration provisions or agreement should clearly specify the names of participants in the arbitration mechanism, and the items subject to arbitration.

The arbitration mechanism will not adjudicate items not specified in arbitration provisions or arbitration agreements.

If the arbitration mechanism finds that it is not the arbitration mechanism specified in the arbitration provisions or arbitration agreement, the litigants should be told to apply to the arbitration mechanism agreed upon.

Article 10. If the litigants have not clearly specified the arbitration mechanism, or have selected various kinds of arbitration mechanisms, they must consult and agree on one kind of arbitration mechanism, and if an agreement

is not reached [the dispute] must be processed without arbitration provisions or an arbitration agreement.

Article 11. The arbitration mechanism will not accept territorial or class restrictions in hearing technical contract disputes.

Article 12. The arbitration mechanism should hear arbitration cases in accordance with unilaterally or bilaterally submitted applications. In cases where the arbitration application is submitted by one litigant, that litigant is the plaintiff and the other is the defendant. When submitted by both litigants, the first to submit is the plaintiff and the other side is the defendant. When both are submitted on the same day it is required that one side be designated as plaintiff and the other the defendant.

Article 13. When the plaintiff submits a request for arbitration, it should include the application form, a copy of the contract, the arbitration agreement, and payment for the arbitration fee, which are to be delivered to the arbitration mechanism as specified in the rules.

The names of the plaintiff and defendant, addresses, the applicants demands, and the pertinent facts and evidence should be clearly written on the arbitration application form.

Article 14. The arbitration mechanism should proceed with the investigation within 10 days of receiving the application form, conform to the following conditions in conducting the hearing, and advise the litigants in writing.

(1) The subject of the requested arbitration is the recognized registered technical contract, or the relevant disputed rights and obligations of the technical development, technology transfer, technical consultation, or technical service.

(2) The arbitration provisions or arbitration agreement are consistent with the demands.

(3) The plaintiff is party to the contract.

(4) The specified defendant is also party to the contract.

(5) There are definitive arbitration demands and factual evidence.

(6) The application period has not exceeded the legal fixed limits of the application for arbitration.

Article 15. The arbitration mechanism should send a notification of receipt and a copy of the plaintiff's request for arbitration to the defendant within 10 days of receipt of application.

The defendant should deliver a reply document and materials to be used as evidence to the arbitration mechanism within 15 days after receiving the notification of hearing and copy of the arbitration application.

The defendant will not influence the arbitration mechanism hearing the case without delivering the reply document within the time limits.

Article 16. The defendant may initiate a counter-suit within the specified time for delivering the reply document. The demands and evidence must be clearly written in the counter-suit document, and the relevant documents attached.

Article 17. When deemed necessary by the arbitration mechanism, the defendant may be asked to pay part of the arbitration fees in advance.

Article 18. If the plaintiff increases the arbitration demands, or the defendant issues a counter-suit, or a third party submits demands relevant to the case, the arbitration mechanism may consider them all together.

Article 19. Copies of the litigant's request document, reply document, counter-suit document, and relevant material for evidence, or other documents, should be made for the litigants and each member of the arbitration board.

Article 20. The litigant may entrust an agent to handle the arbitration actions. The agent must present the signature of his client, and a certified authorization. Within the terms of the authorization, the effects of the legal outcome of the arbitration as are incumbent upon the agent will be born by the client.

Article 21. In dispute cases where, because of the litigants actions or other reasons, the decisions of the arbitration cannot be executed or it is difficult to carry them out, the arbitration mechanism may, in accordance with the desires of the other litigant or stipulations of the law, request the People's Court at the location of the property of the opposing litigant or the arbitration mechanism to take measures to ensure compliance.

Chapter III. Arbitration Court

Article 22. The arbitration mechanism will make up a list of the names of the arbitrators. Arbitrators will be professionals who specialize in one or more disciplines. Arbitrators with one or more specialties involved in arbitrating technical contracts have equal rights and responsibilities.

Article 23. After the arbitration mechanism has received a request for arbitration it must deliver the list of arbitrators to both litigants, and organize an arbitration board in accordance with the following procedures:

(1) Within 10 days of receiving a notification document the plaintiff will appoint one arbitrator.

(2) Within 10 days of receiving a notification document the defendant will appoint one arbitrator.

(3) Within 5 days of receiving names appointed by the plaintiff and defendant the arbitration mechanism will designate the chief arbitrator.

Article 24. The two litigants may jointly appoint a single arbitrator to form the arbitration court, and he alone will adjudicate the case.

Article 25. The plaintiff or defendant may entrust the arbitration mechanism to appoint an arbitrator.

If the arbitrator has not been appointed by the plaintiff or defendant within the time limit of article 23 of this regulation the arbitration mechanism is authorized to make the decision.

Article 26. When the arbitration case has two or more plaintiffs or defendants, the two plaintiffs or two defendants must appoint one arbitrator between them. If the two plaintiffs or two defendants have not, together, appointed one arbitrator within the time limits of article 23 of this regulation, the arbitration mechanism is empowered to make the decision.

Article 27. If the arbitrator has a conflict of interest in the case that may affect a fair judgment of the case, he must request that he be withdrawn by the arbitration mechanism. If the litigant considers that there are circumstances that require withdrawal of an arbitrator he has a right to request the arbitration mechanism to withdraw him.

The decision to withdraw an arbitrator will be left to the arbitration mechanism.

Article 28. If because of withdrawal or other reasons an arbitrator cannot fulfill his obligation, the litigant should appoint a new arbitrator in accordance with the original procedure.

Chapter IV. Hearing

Article 29. The litigants should give testimony with the facts on which they base their claims or replies. The arbitration court may do its own investigation and gather evidence as it deems necessary.

Article 30. Types of evidence are listed as follows:

- (1) Documentation.
- (2) Material evidence.
- (3) Information observed and heard.
- (4) Witness' testimony.
- (5) Litigant's statement.
- (6) Authenticating opinion.
- (7) Record of examination.
- (8) Technical evaluation of materials.

Article 31. Evidence will be assessed by arbitration court.

Article 32. In hearing technical contract disputes submitted for arbitration that bear on national security and major national interests that should be kept secret, the arbitration mechanism should take measures to protect the state secrets.

When the litigants have agreed in the contract on the duties and obligations of secrecy, or at time of application for arbitration request protection of technical secrets, the arbitration mechanism should protect the litigants secrets.

This regulation applies to the relevant evidence in the arbitration process.

Article 33. The arbitration court should conduct an open hearing of the case, but at request of both litigants or with the consent of both litigants, the arbitration court need not hold an open hearing.

Article 34. The date and place of an open court hearing will be determined by the arbitration mechanism, and the litigants should be informed 30 days in advance. If for some legitimate reason a litigant can't get to the court on time he should request the arbitration mechanism to delay the open hearing 15 days in advance.

Article 35. When the arbitration court holds an open hearing, if for some unacceptable reason a litigant or agent does not attend, the arbitration court may conduct by default and render a judgment.

Article 36. Only under one condition will an arbitration court not proceed with an open hearing that has been requested by both litigants.

Unless agreed upon by both the arbitration court and both litigants, an individual who is not involved in the dispute may not attend the hearing.

Article 37. The arbitration court should make a written or taped record of the hearing, and may also request the litigants or their agents, witnesses, or other concerned persons to sign the written record.

Article 38. The arbitration court may on request of one or both litigants, on ascertained facts and differentiated responsibilities, make an adjustment before or during an open hearing. The arbitration court should document the adjustment on which the litigants have reached a conciliatory agreement. If the litigants disagree with the adjustment or the adjustment is unaccomplished, the arbitration court should render a judgment.

Article 39. If the arbitration mechanism has received a case that the litigants have themselves reconciled, the plaintiff should promptly request that the arbitration mechanism withdraw the case. The arbitration mechanism will make the decision whether to withdraw the case.

Once a case has been withdrawn, if a litigant resubmits a request for arbitration, the arbitration mechanism is authorized to decide whether or not to accept the case.

Chapter V. Adjudication

Article 40. Within 30 days after concluding the hearing the arbitration court should render an arbitration decision.

The arbitration decision includes an arbitration decision document and an adjustment document which are sent to the litigants.

Article 41. An arbitration decision is based on the decisions of the majority arbitrators. The opinions of the minority arbitrators should be an attachment to the record.

Article 42. The arbitration decision should be clearly written.

(1) The main points of the case, the arbitration application, facts and causes of the dispute.

(2) The facts as accepted by the arbitration decision, and basis in laws as were applied.

(3) Bearer of the results of the arbitration and expenses born by the arbitration.

(4) The time limit for fulfilling the arbitration decision.

The arbitration decision is signed by all arbitrators of the arbitration court and bears the seal of the arbitration mechanism.

Article 43. As deemed necessary by the arbitration court or as proposed by the litigants with approval of the arbitration court, on questions pertinent to the case during the course of the arbitration, intermediate judgments or partial judgments may be rendered.

Article 44. In technical contract disputes that involve patent rights, requests for patent rights, implementation of patent rights, rights to use unpatented technical end products, rights of transfer and rights of those who finished up a technical end product, that are being processed legally by a relevant S&T committee or patent administrative organization, the arbitration mechanism should make a new judgment after a verdict is reached by the entrusted relevant organization.

Article 45. In contract disputes relating to technology level, and academic appraisals, the arbitration mechanism may remake judgment after a scientific research organization or academic body appointed by a provincial level or above S&T committee member has rendered an opinion on the matter.

Article 46. When the Technical Contracts Arbitration Committee of the State S&T Commission acting on arbitration decisions already legally rendered by the various arbitration mechanisms find that errors have in fact been made, it is authorized to direct the arbitration mechanism to change the arbitration decision or conduct a new arbitration.

When the various arbitration mechanisms find that, in fact, errors have been made in decisions already legally effected, they must change the arbitration decision or conduct a new arbitration, and they should report it to

the Technical Contracts Arbitration Committee of the State S&T Commission, and request examination and approval.

Article 47. In accordance with Article 46 of this regulation, in making a decision to change an arbitration decision or conduct a new arbitration one of the conditions listed below must obtain.

(1) A violation of legal process in constituting an arbitration court or arbitration procedure.

(2) Insufficient primary evidence for a conclusive fact.

(3) Error in application of the law.

(4) Corruption, receiving bribes, favoritism and irregularities, perversions of the law in rendering decisions by an arbitrator in the act of handling a case.

Chapter VI. Execution

Article 48. The law takes effect on the day that the arbitration decision is sent to the litigants. No litigant may then file a suit in a court of law.

Article 49. Within the time limit specified by the arbitration decision, the litigants should take action to fulfill the arbitration decision. When a litigant does not comply, the other litigant may request the People's Court to execute the decision, or may work through the arbitration mechanism that ruled on the case to request the People's Court to execute the decision.

Article 50. If the People's Court, in accordance with Article 217 of (The Civil Suit Law) declines to consider executing the arbitration decision, the litigant may either re-apply for arbitration or file suit through the People's Court.

Chapter VII. Supplement

Article 51. The arbitration document should be sent directly to the litigants. If it is difficult to deliver it directly, the arbitration mechanism may mail the document or entrust an S&T committee member at the location of the litigant to deliver it. The recipient will write the date on the delivery receipt and sign it, or affix a seal. The date the recipient writes on the signed receipt is the date of delivery.

Article 52. This regulation is interpreted by the Technical Contracts Arbitration Committee of the State Science and Technology Commission.

Article 53. This regulation is effective on 1 November 1991.

Outlay for S&T Made Public for First Time

91FE0559B Tianjin ZHONGGUO JISHU SHICHANG
BAO [CHINA TECHNOLOGY MARKET NEWS]
in Chinese 20 Mar 91 p 1

[Article by reporter Liu Zongxiang [0491 1350 4382]: "China Announces Unified Specifications and Indices for S&T Expenditure Inputs for First Time, Relying on S&T To Invigorate the Economy, Reinforcing Management's Adaption to Opening Up"]

[Text] Since reform of the S&T allocation system, the issue of China's S&T expenditures and inputs have received widespread attention from S&T circles and all of China's people. In 1990, a coordination group composed of the State Science and Technology Commission, Ministry of Finance, State Statistics Bureau, Chinese Academy of Sciences, and State Natural Science Foundation and a study group composed of over 20 experts from Qinghua University, China Science and Technology University, the Non-Ferrous Metals Industry Corporation, and other units worked for over 9 months to formulate unified specifications and calculation methods for China's S&T expenditure inputs.

1. A report issued by the study group provides China's first design for a set of unified specifications and calculation methods for S&T expenditure inputs that can be used for international comparison and which conform to China's national conditions. They standardize the definitions of research and experimental development (R&D) activities, S&T activities for the stage of converting S&T achievements into commodities, and S&T service activities that are supported by China's S&T expenditure inputs.

2. The coordination and study groups proposed four expenditure indices that reflect the overall situation for China's S&T expenditure inputs in the present stage: total expenditures on S&T activities (not including S&T loans); ratio between research and experimental development (R&D) expenditures and gross national product (GNP); financial S&T expenditure allocations; and S&T loan totals and actual grants.

3. These unified specifications and calculation methods were used to determine the situation for China's S&T expenditure inputs over the past several years. The results of the calculations were: total expenditures on S&T activities (not including S&T loans) were 30.05 billion yuan, the ratio between research and experimental development (R&D) expenditures and gross national product (GNP) was 0.7 percent, in which GNP was 1,740 billion yuan; total financial S&T expenditure allocations were 13.66 billion yuan; and total S&T loans were 2.89 billion yuan and actual grants were 6.12 billion yuan.

4. Several major development trends in China's S&T expenditure inputs over the past few years were analyzed. Major changes have occurred in the structure of the sources of China's S&T expenditure inputs. Of the

30.05 billion yuan in total expenditures on S&T activities in 1990, financial allocations accounted for 13.66 billion yuan or 45.5 percent while non-financial allocations accounted for 16.39 billion yuan or 54.5 percent, which was more than the proportion from financial allocations. This shows that reform of the S&T system has already led to the appearance of multiple channels for China's S&T activity inputs, which also reflects the results of S&T circles actively orienting themselves toward the economy. The R&D/GNP ratio represents a nation's situation in S&T innovation activity inputs and is a figure that can be compared internationally. The figure 0.7 percent indicates that China is at a middle level among the developing nations. In R&D expenditure inputs, financial allocations account for 60 percent, which shows that government finances are still the main source of investments in R&D activities. China's financial S&T expenditure allocations in 1990 were up about 6.8 percent over 1989, while GNP over the same period was up 10.2 percent (actual figures), so inputs in this area will require additional reinforcement. S&T loans are a new channel for S&T investment capital that has appeared in the past few years. On the one hand, it reflects changes in China's S&T operational mechanisms and on the other hand it is an inevitable trend for optimized capital investment directions in financial circles. Integration of S&T with finance is revealing growing vitality but S&T loan totals are still small at present. As a source of capital support for converting achievements into direct forces of production, this number usually should be several times expenditures on R&D, so there should be substantial increases in S&T loans. Projections indicate that China's S&T loans will reach or surpass total financial S&T allocations during the later part of the Eighth 5-Year Plan and become one of the three main pillars of China's S&T inputs.

Trends of Technology Market in China

91FE0819E Beijing ZHONGGUO KEJI LUNTAN
[FORUM ON SCIENCE AND TECHNOLOGY IN
CHINA] in Chinese No 4, 18 Jul 91 pp 56-57, 64

[Article by Wang Zengrong [3769 2582 2837]: "Analysis of Characteristics and Development Trends of China's Technology Market"]

[Text] It has been 10 years since the appearance of China's first technical service organ which undertook technology trade activities. The fastest development of China's technology market, however, came after the CPC Central Committee issued its "Decision on Reform of the S&T System" in 1985. Guided by the principle of "opening up, invigoration, support, and guidance", China's technology market saw its technology contract business volume increase from 720 million yuan in 1984 to more than 8 billion yuan in 1989, a 10-fold increase. In the broad realm of technology trade, substantial advances have been made in establishing a variety of forms of administrative systems and in establishing and perfecting the related policy, legal, and management systems, and in other areas. This is particularly true for

the promulgation of the Technology Contract Law and its implementation articles, which more effectively promoted the development of China's technology trade activities in a healthy and orderly direction, and the technology market has become an important bridge that integrates science and technology with economic construction.

I. Main Characteristics of China's Technology Market

It has not been long since China established its technology market and we have been continually perfecting our market mechanisms. China's technology market is different from international technology trade. For example, license trade is a representative form of international technology trade, but this is only a small portion of China's technology market activities. These differences constitute the characteristics of China's technology market.

A. The primary technology trade arrangement in China's technology market is technology development and technical services, whereas technology transfers account for a very small proportion.

The Technology Contract Law divides trade activities in China's technology market into the four categories of technology transfers, technical services, technical consulting, and technology development. Statistics show that technology transfer activities account for a very small proportion of the total volume of China's technology trade, for 12.91 percent in 1987, 17.47 percent in 1988, 9.73 percent in 1989, and 16.43 percent in 1990. Technical services accounted for 50.21 percent in 1989 (when the traditional statistical specifications included technical consulting) and 39.91 percent in 1990 (when the new statistical specifications did not include technical consulting), for a total of 47.70 percent when technical consulting is included. Technology development activities accounted for 27.03 percent in 1987, 31.99 percent in 1988, 32.44 percent in 1989, and 36.50 percent in 1990. Technical consulting and technical services use S&T to provide intellectual services to economic construction and social development. This transfer of technology is extremely important for China with its relatively backward S&T levels, especially in many poor and backward regions. The statistical data show, however, that the levels of China's technology trade are very low at present and that efforts should be made to raise them.

B. The scale of technology trade is relatively small.

Statistics show that the average volume of trade for each technology contact was 31,100 yuan in 1989 and 36,300 yuan in 1990. In 1990, the average volume of trade for each of the four categories of technology contracts in China's technology market was 85,100 yuan for technology development, 80,000 yuan for technology transfers, 22,100 yuan for technical consulting, and 24,200 yuan for technical services. It is apparent that the scale of China's technology trade is rather small.

C. Research and development organs are the biggest buyers of technology commodities.

China's technical forces are extremely unevenly distributed, large numbers of S&T personnel are concentrated in R&D organs, and enterprises (especially medium-sized and small enterprises) have shortages of technical personnel, which determines that China's technology commodities are flowing from R&D organs to industrial enterprises. Technology commodities sold by R&D organs as a proportion of the volume of trade in all of China's technology contracts were 40.46 percent in 1987, 38.23 percent in 1988, 50.96 percent in 1989, and 36.54 percent in 1990.

D. We have a unique technology market management system.

To promote flourishing development of our technology market and accelerate the conversion of technological achievements into forces of production, the state has implemented preferential policies for technology trade. At the same time, to ensure correct implementation of the state's preferential policies for the technology market, we must reinforce technology market management. Management of the technology market is highly technical and is entirely different from industrial and commercial management in the economic market. For example, there must be written and signed contracts, management of technology contracts, acknowledgement and registration, and so on. Acknowledgement and registration are used to eliminate non-technology contracts from technology contracts. Moreover, we must also divide technology contracts into four categories, examine their technical income, examine bonuses, and so on. These require formulation of a series of matching administrative laws and regulations to regulate behavior in the technology market and form a technology market management system. In developed nations, where technology commodities are traded like actual commodities, this type of management work is unnecessary.

II. Development Trends in China's Technology Market

There have been major advances in China's technology market over the past few years and they have played a major role in the development of our national economy and S&T activities. Over the historical course of development of the planned commodity economy, however, China's technology market is only at the initial stage. It is just unfolding and there is great potential for development. This is manifested concretely in the following areas:

A. There will be a great increase in technology trade.

The total volume of transactions for China's technology contracts has held at the 7 to 8 billion yuan level for the past 2 or 3 years. However, technology transfers only accounted for 10 to 18 percent, that is, 800 million to 1.2 billion yuan or about \$200 million to \$300 million, which is only about 1.5 percent of the amount of world license trade (assuming that all of China's technology

transfer activities are license trade). Projections indicate that by the end of this century, the volume of international technology trade will reach \$200 billion. As China's national economy develops, there will also be a substantial increase in technology trade and its rate of growth will certainly exceed the rate of growth in China's material commodity trade. If we calculate on the basis of a 12 percent average yearly increase in the international technology trade volume and use China's 1990 figure of 7.5 billion yuan as a base figure, it could reach 23 billion yuan by the end of this century. This may be a conservative estimate.

This type of analysis is not merely theoretical calculation because it does have a basis. The concern of the entire party and the entire nation for S&T progress has created excellent opportunities for developing our technology market, especially following development of China's commodity economy and reinforcement of our understanding of commodities. Market mechanisms have fostered their full advantages in the area of promoting the conversion of technological achievements into forces of production. Industrial enterprises and other production departments are relying more on S&T progress and their enthusiasm for purchasing technology from the technology market is much greater, so the volume of technology trade will grow substantially. At present, China has 8.16 million industrial enterprises and the average amount each enterprise spends to purchase technology from the technology market is only 585 yuan. On the average, 45 enterprises purchase a technology from the technology market, which is woefully inadequate. This shows that there is major potential for developing China's technology market.

B. Gradually raising of the levels of technology trade will move China's technology market toward internationalization.

As the previous analysis shows, the levels of China's technology trade are still rather low at present and technology transfer contracts account for a very small proportion of the total volume of technology contract transactions in China. As S&T levels in China are raised and the development of high-tech industry and upgrading of traditional industry is accelerated, the levels of technology trade will rise. The volume of technology exports, especially the volume of technology exports to developing countries, will increase rapidly. China's technology market will move toward internationalization and more technology and products will be pushed into international markets.

C. The functions of intermediary organs will develop and strengthen.

The technology market is a bridge linking S&T and the economy. A major portion of this bridging role is performed by intermediary organs.

During the initial period of the development of our technology market, many technological achievements

exist that can be converted quickly into forces of production and it is very easy for intermediary organs to play their role. As the technology market develops and many technology trade organs are established, many scientific research organs and institutions of higher education can convert technical achievements themselves into forces of production, so intermediary organs must change their functions and begin to enter at the stage of application and development of laboratory achievements and participate in work to industrialize achievements in order to obtain technical achievements with significant benefits. Many intermediary organs may shift to supervising and protecting the rights of legal persons in contracts and handling contractual disputes in court in place of legal persons as their primary work. Some intermediary organs will foster the advantages of their own overall functions and make organizing the technological matchup of many technology development units their primary work.

Standardization of work in China's technology market will also lead to standardization of the activities of intermediary organs. For example, they may hold several major technology trade fairs on fixed schedules and at fixed sites throughout China.

D. Gradual standardization of technology market behavior will move China's technology market onto the track of healthy and orderly development.

The basic laws for technology market activities are the Technology Contract Law and the associated regulations for its implementation and the Patent Law. To standardize technology market behavior and correctly implement the Technology Contract Law, the State Science and Technology Commission has formulated several matching regulations like the Technology Contract Affirmation and Registration Management Methods, and so on. When these laws and regulations are conscientiously adhered to, technology contract arbitration organs are established and begin functioning, technology market management regulations are promulgated and implemented, the technology market management system is straightened out, the quality of technology market personnel is improved, and large-scale technology trade activities become standardized, then it can be said that China's technology market basically has moved onto a healthy and orderly track.

As the technology market develops and when technology market behavior is standardized, the concept that technology can circulate in the market as a commodity just like things will truly be universally accepted by people, there will be substantial improvements in the treatment of S&T personnel, skilled personnel and knowledge will be universally respected by society, the insignificant role of the state's preferential policies for the technology market will eventually be eliminated, technology market management will no longer have its own unique properties and characteristics, and there will be no need for the

management system to exist. This is the ultimate objective of technology market management workers. However, to achieve this goal, we will have to reinforce technology market management work for a considerable period of time, at least through the end of this century, maintain the state's preferential policies toward the technology market, and promote healthy development of the technology market.

Call for Legal Protection of Classified Technology

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[STUDIES IN S&T MANAGEMENT] in Chinese No 2,
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[Article by Wu Chuangsong [0702 0482 2646] of the Guangdong Province Science and Technology Laws and Regulations Research Office: "Legal Protection for Classified Technology"]

[Text] Reform of China's S&T structure has opened up technology markets, converted technical achievements into commodities, and promoted S&T progress and economic development in China. However, during the process of converting technical achievements into commodities, there have occasionally been disputes concerning rights over technology, and most involved disputes regarding the rights over classified technology. For example, some S&T personnel have used their positions to transfer part or all of the classified technology of their original units to other units while holding second jobs or during the circulation process and infringed on the technical rights of their original units. These classified technologies are non-patented technical achievements and their rights are not protected by the Patent Law. As a result, units which have been harmed do not know how to protect their rights over the technology of their unit and legislative departments have felt extremely ruthless when handling such disputes. Thus, discussion of legal issues regarding the protection of classified technology is of very great and real significance.

The technologies we usually apply can be divided into three categories: public technology, patented technology, and classified technology. Compared to public technology and patented technology, classified technology refers to technology that can be utilized directly in industrial production or in production in other industries, or it may be the technical knowledge, information, or experience needed to implement these technologies, and they must maintain this type of secrecy at the time by the units or individuals who invented or applied these technologies. Actually, they are a type of proprietary technology that has not been made public, and include technical achievements where no preparations have been made to apply for a patent, technical achievements where they have prepared for but not yet applied for a patent, and technical achievements where an application has already been made but which have not yet undergone the procedure for "early public notification" by the Patent Bureau. Compared to other technologies, classified technology has the following characteristics: 1) It is

confidential. This type of technology mainly relies on the secrecy of the parties concerned to maintain their proprietary qualities. As soon as it is made public, it enters the public realm and is publicly known and utilized, so it loses its proprietary qualities. 2) It is applied. It can enter the realm of industrial production and application and can be traded in markets. 3) It is a type of non-patented technical achievement. Some may have the proper conditions for patenting while others may lack the proper conditions for patenting, but they are not the objects of protection by the Patent Law.

These properties of classified technology determine that it will receive protection for their uniqueness and formidable properties. First, classified technology does not exclude R&D by other persons. Any third party who independently obtains a similar technology can use or transfer this technology. Moreover, a patented technology does not exclude others from applying or transferring a similar technology during the period of its effective legal protection. Second, classified technology has no temporal, regional, or novelty restrictions and is simply given protection and has monopolistic and proprietary properties by not being leaked during the utilization or transfer process. Third, as soon as a classified technology is divulged, it can cause losses that are hard to compensate and these losses can not be compensated by simple reparations measures.

Regarding protection of classified technology, China has no special laws, but many departmental laws or regulation documents do contain provisions on protecting rights over classified technology. The main laws and regulations in this area: "People's Republic of China Civil Law General Rules", "People's Republic of China Technology Contract Law", "People's Republic of China Technology Contract Law Implementation Rules", "Provisional Methods for Administration of Technology Markets", "Interim Provisions of the State Council Concerning Technology Transfers", "Technology Import Contract Management Regulations", and so on. The relevant provisions in these legal documents provide a legal basis for protecting classified technology but they are incomplete. For example, there is Article 118 in the "People's Republic of China Civil Law General Rules": "when the copyrights, patent rights, trademark use rights, discovery rights, invention rights, and other technical achievement rights of citizens and legal persons are subjected to plagiarism, misrepresentation, imitation, and so on, they have the right to demand that the infringement be stopped, that the effects be eliminated, and that they be compensated for losses". Although this regulation provides a legal basis for assigning civil responsibility for infringement on S&T achievement rights, its provisions lack concrete measures for punishment, its operational properties are weak, and its protections are not tight. Given the current situation with S&T legislation in China and the uniqueness of classified technology, the owners of classified technology should first of all reinforce their administrative measures over classified technology and take action to adopt preventive

measures. When a classified technology has been leaked and subjected to infringement, concern should be given to seeking legal protection in order to obtain a remedy. Usually, protection can be provided via the following routes.

1. Protection by seeking responsibility for violations by the parties concerned. The basis for seeking responsibility for violations by interested persons to protect classified technology is contracts. Owners (units or individuals) of classified technology can use contractual relationships to make specially-designated concerned parties respect the secrecy of classified technology and not leak classified technology of which they have knowledge or contact to third parties or not to utilize classified technology which they have not agreed upon. For example, during technology transfers, the parties concerned in a contract can include secrecy clauses for classified technology based on the provisions in Article 39 and Article 41 of China's "Technology Contract Law" in technology transfer contracts to ensure that the recipient of the technology transfer accepts the obligation of not leaking the classified technology. If the recipient violates the secrecy clauses in the contract and utilizes or leaks its classified technology within the agreement of the transferring party, the transferring party can use violation of the contract as grounds for filing suit against the recipient to request that the courts order the violating act stopped or issue a decision that the recipient committing the violation compensate for the losses. In another example, enterprises can establish classified technology secrecy contracts with their employees. If an employee violates the agreement, responsibility for the violation can be pursued to protect classified technology. This is a relatively common way to protect classified technology, but this means of protection has a major defect. Contracts are agreements on rights and duties between the parties concerned and contracts only have binding force on the parties concerned. They do not have binding force on third parties. Thus, if one party to a contract that has secrecy obligations violates the secrecy clauses in the contract and leaks a classified technology to a third party, the party which is harmed can only file suit based on the contract against the party that assumes secrecy obligations in the contract and cannot file suit against the third party. If a suit is filed against the third party, violation of the contract cannot be used as the basis and a suit must be filed based on other grounds for a lawsuit.

2. Protection by pursuing civil responsibility for infringement by the parties concerned. This method of protection refers to the ability of owners of classified technology to pursue civil responsibility for acts that intentionally or accidentally infringe upon the rights over classified technology and seek protection based on the "People's Republic of China Civil Law General Rules" or other relevant legal provisions. Using this method to protect rights over classified technology can expand the scope of the protection to third parties. The advantage of this method is that when the party harmed uses

infringing acts as grounds for filing suit, it only has to prove that certain rights exist and that these rights have been infringed upon by the infringing party and can then demand that the infringing party stop the infringement or compensate for losses, and it does not require that any type of contractual relationship exist between them.

3. Protection by seeking administrative responsibility for the parties concerned. This method of protection refers to the relevant functional departments of government or the units where the parties concerned in the infringement of classified technology rights are located using administrative punishments like warnings, recording demerits, suspension, reductions in grade, leave for observation, discharge from public employment, and so on for the parties concerned in infringement of classified technology on the basis of relevant administrative laws or administrative regulations. For example, when S&T personnel infringe on the classified technology rights of their unit while working at a second job, the scientific research unit where they work can give them administrative punishments.

4. Protection by seeking criminal responsibility for those directly responsible. There is some disagreement in regard to whether or not there should be criminal responsibility for acts which infringe on classified technology. Under the conditions of rapid development of science and technology in the modern era, the status of classified technology in competition is becoming increasingly important. As soon as a classified technology is leaked through theft or fraud, it may cause an enterprise to suffer losses itself, and it may directly or indirectly affect China's competitive position in international markets. Thus, we should begin with maintaining social order and protecting the public interest and provide for punishment of acts which infringe on classified technology in our criminal law to strengthen protections over classified technology. There is an international trend toward using the weapon of criminal law to protect classified technology rights and there are legal precedents in China. Therefore, acts to steal or defraud classified technology and gain illegal benefits should combine the pursuit of civil responsibility and economic responsibility with punishment for theft or fraud. Based on provisions in China's Penal Code, theft refers to acts with the goal of obtaining something illegally and secretly stealing rather large amounts of public or private property. Fraud refers to acts with the goal of obtaining something illegally by using the methods of fabricating facts or concealing the truth to obtain rather large amounts of public or private property through deception. Thus, acts of infringement on classified technology must conform to the characteristics of theft or fraud in criminal law provisions before they can constitute crimes. This category of crimes touches upon complex scientific and technical activities, so when pursuing criminal responsibility for persons whose acts infringe upon classified technology, we must be concerned with the boundary between those that are crimes and those that are not crimes but are proper acts cannot be attacked as constituting crimes.

Strengthening S&T Security in Technology Export Urged

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[STUDIES IN S&T MANAGEMENT] in Chinese No 2,
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[Article by Yu Chisi [0151 6375 1835] of the Guangdong Provincial Science and Technology Commission Achievements Department: "S&T Security Evaluation Work in Technology Exports"]

[Text] As China's opening up to the outside world continues to develop, international S&T exchanges and cooperation become increasingly dynamic, and technology exports continue to grow each year, many S&T personnel are gradually orienting themselves toward international technology markets to ship out technology and engage in technology product trade with foreign countries, which has played an active role in promoting the integration of S&T and the export-oriented economy. Still, we must soberly note that international S&T activities involve both friendly cooperation as well as intense struggle, and that certain persons and intelligence agencies in foreign countries will employ various types of contact arrangements and use legality to conceal illegality in trying in every way possible to steal China's S&T secrets and seek economic benefits, and even directly endanger China's security. Thus, the question of how to do S&T security evaluation work in technology exports properly without affecting S&T exchanges and export trade while also guaranteeing the security of China's S&T has become an important issue that must be solved as we undertake S&T activities open to the outside world at the present time. Below, I will discuss several immature viewpoints in conjunction with Guangdong's experiences.

I. Increase Our Understanding of S&T Security Evaluation, Continually Strengthen the Sense of Urgency Concerning Technology Export Security Work in Leaders and S&T Personnel at All Levels

Technology export work concerns two questions. One is the question of the properties of technology and the other is the question of security. The ability of a technology to receive a good price is related to its technical levels and the degree of its security level. For the degree of security levels, in general, the higher the security level of a technology, the better its price. Certain people disregard the state's S&T security to gain a good price and thereby seriously endanger our national security and damage the state's economic interests. In today's world, S&T are increasingly permeating the military, economic, and other realms, and all countries are adopting a variety of measures to monopolize and protect their own research achievements. They are also using every opportunity and means to obtain S&T intelligence to attain the goal of protecting their own country's S&T advantages and developing their economic interests. Whether or not a technology is a state secret and whether or not it can be openly circulated depends on carrying out the necessary S&T security evaluation before a clear determination

can be made, and only then can leaks of state S&T secrets be prevented. For this type of work, besides the need for concern in scientific research units, institutions of higher education, and enterprises, leaders and cadres in administrative departments at all levels must increase their understanding, continually strengthen their sense of urgency concerning technology export security work, and absolutely avoid slackening their vigilance.

II. Establish and Perfect an S&T Security Evaluation Responsibility System

Over the past several years, enterprises, scientific research units, and institutions of higher education have been engaged in increasingly frequent economic and technical exchanges and cooperation, but their propaganda and education concerning S&T security work has not kept pace. They lag behind in understanding and have even ignored S&T security work in their technology export activities. Several enterprises have only been concerned with immediate benefits and have neglected the losses to our national interests that might arise from making a technology public. Some S&T personnel have failed to follow procedures for submitting reports for approval in order to enable their own research achievements to gain recognition and development in foreign countries or to gain opportunities to go to foreign countries. They fail to undergo S&T security evaluations and engage in public exchange and transactions with foreign countries indiscreetly and prematurely, which has damaged our national interests. Thus, from the administrative perspective, the main reason these problems have appeared is that no one is responsible for S&T security and the system of reporting for evaluation is imperfect. To do S&T security evaluation work properly, we feel that responsibility for S&T security evaluation should be carried out at three levels. 1) While assuming responsibility for evaluation, enterprises, scientific research units, and institutions of higher education should supplement this with having technical officials in a S&T security responsibility system. 2) Administrative departments should assume responsibility for initial evaluations and be responsible for strictly checking and managing the content of special technical secrets. 3) Science and technology commissions and foreign economic relations and trade commissions should be responsible for approving technology exports and for evaluating technical secrets and contracts.

III. Establish and Perfect an S&T Security Evaluation System Adapted to China's Technology Exports

To ensure that technology export work conforms to the requirements of the state's present technical and economic policies, we must establish and perfect an S&T security evaluation system. Given present circumstances, we can consider action in the following areas. 1) Reinforce the organizational and promoting role of technical engineers (or technical officials) in S&T security work and give them real responsibility for evaluating the security of technical items. 2) Establish and replenish S&T security organs at all levels, begin with actual needs,

establish S&T security organs in existing export-oriented large and medium-sized enterprises, scientific research units, and institutions of higher education, outfit them with S&T security personnel, and organize S&T security evaluation groups composed of leading cadres, S&T management personnel, and specific specialized technical personnel to gradually form a basic framework for an evaluation system. 3) Establish and perfect an integrated system for S&T security and technology trade evaluation, organize combined evaluation groups from S&T management departments and foreign economic relations and trade management departments, and combine reinforcement of S&T security work with active encouragement of technology exports to earn foreign exchange and open up channels for technology exports.

IV. Reinforce Conventional Training Work on Knowledge of S&T Security and Technology Exports

To enable S&T achievements to earn foreign exchange during the process of being shipped to foreign countries and to protect the state's classified technology, we must undertake propaganda and education work to make our vast numbers of S&T personnel and personnel involved in foreign trade understand and grasp the state's relevant policy provisions. We should undertake work in two main areas. One is to collect, arrange, and print technology export trade and S&T security management work handbooks for S&T security departments and technology export trade departments and issue them to all basic-level units and administrative departments for use as propaganda and educational materials and in management work. The second is for S&T and foreign trade administrative departments to organize technology export management classes at different levels in a planned, focused, and gradual manner and in groups and phases to provide instruction on basic theory, policies, requirements, reporting procedures concerning S&T security and technology export work and enable personnel involved in technology export trade and management work to understand them and implement them in their work. Since 1990, Guangdong Province has held over 10 of these classes in various cities and over 800 people have participated in the study. They have produced rather good results, and they have promoted the development of technology export work and reinforced management of technology exports.

V. Put in Place Matching S&T Security Evaluation Personnel, Strengthen Forces in Technology Export Management Work

The present situation in Guangdong Province shows that S&T security organs and personnel have never been perfected and that one reason for this is the failure to form a larger environment for S&T security. Enterprises

are only concerned with product sales and compete for fame and customers. Scientific research units and institutions of higher education only want their own technology to be sent to foreign countries for exchanges. The result is that foreigners pay very low prices and easily send technology out as gifts. Because they have no S&T security cadres, some units "grab people as replacements" temporarily when evaluating technology exports and implement no concrete management and may even separate technology security from foreign trade. The existence of this situation has already directly affect healthy development of technology export work. As a result, we propose that relevant departments of the state include technology security personnel in their plan compilation and that all regions increase the number of technology export management personnel based on the situation in their technology export work. All units which export technology must have a specific proportion of S&T security personnel matched with truly responsible comrades with college (or polytechnical) education levels or higher to undertake S&T security work and integrate S&T security personnel with technology export management organs.

VI. Focus on Real Problems in Technology Security Evaluation

This is an important link in reinforcing evaluation of technology export items, guaranteeing the quality of technology exports, and protecting China's reputation, and it is an important aspect of technology security evaluation. Mainly, it involves doing work well in these five areas. 1) Analyzing whether or not an exported technology is a mature industrialized technology in China or whether it is a newly-developed high or new technology or new product that occupies a vanguard status in China. High and new technology that occupies a vanguard status in China should be strictly controlled and usually should not be considered for export. 2) Analyzing whether or not an exported technology is a regular technology in China or whether it involves specific technical know-how and a technology that would affect exports of China's existing products as soon as it is exported. In principle, China's unique traditional technologies and technical know-how should not be exported. 3) Patent rights should be obtained for important patented technology exports in the region to which they are exported. 4) Items of technology that have been determined to have security value after classification by security grade assessment methods for S&T achievements should generally not be exported. 5) There should be frequent analysis of technology export items based on the extent of demand for a technology in international markets and continual readjustment of the security grades or control of the range of countries to which technical items are exported.

S&T Policy in Eighth 5-Year Plan Reviewed**Li Xu'e Outlines His Plan**

91FE0525A Beijing RENMIN RIBAO in Chinese
6 Mar 91 p 4

[Article by reporter Wang Yougong [3769 0645 1872]: "State Science and Technology Commission Offers Ideas for Eighth 5-Year Plan, National Science and Technology Work Conference Opens in Beijing"]

[Text] Li Xu'e [2621 4872 6759], deputy director in charge of day-to-day affairs in the State Science and Technology Commission, revealed for the first time China's tentative ideas for S&T work during the Eighth 5-Year Plan at the National Science and Technology Work Conference which opened in Beijing on 4 Mar 91.

1. The overall requirements for the "863" high technology research plan is that projects for targeted products planned for completion before the year 2000 must definitely make breakthroughs in key technologies during the Eighth 5-Year Plan. Besides completing tasks, we also must train high-level skilled S&T personnel.

2. Investments in basic research will be increased each year during this period to reinforce S&T development reserve strengths. Consideration will be given to selecting 79 preferential realms in disciplines in 15 areas for focused support.

3. Rural S&T work must step up to a new stage. We will try to form comprehensive development for 300 pillar industries and 100 regions along with the corresponding service system on a national scale. We will continue to develop 100 sets of advanced appropriate technology equipment, train 2 million skilled S&T personnel of all categories, and arrange for 100 preparatory development projects for commercialization.

4. The "Torch Plan" should focus on establishing several high and new technology industry development zones. In addition to promoting the conversion of high and new technology achievements into commodities, we also must accelerate their diffusion and permeation into traditional industry and try to achieve 50 billion yuan in high-tech industry value of output in China by 1995 and 120 billion yuan by the end of this century.

5. In the area of extending S&T achievements, we should combine reinforcement of "extension" legislation and perfecting matching policies with a further emphasis on S&T extension work and staff construction.

6. In the area of promoting social development, we will focus on research work on major social development topics in six areas including development of population control technology, pharmaceutical sanitation, and medical instruments, the ecological environment, natural disaster prevention, and so on.

7. We will make major efforts at promoting S&T progress in enterprises, and focus on formulating "Regulations for Senior Engineers in Enterprises", "Enterprise S&T Progress Assessment Standards", and other related regulations. We will organize active participation by all S&T personnel in technical progress, assimilation, and major technical upgrading projects. In addition, we should establish and perfect a series of indicator systems and service systems for S&T progress in township and town enterprises and guide a large number of township and town enterprises onto the track of forming groups.

8. In the area of S&T fund inputs, we will try to have the proportion of state revenues invested in S&T expenditures increased from the present 0.7 percent or so to more than 1 percent by the end of the Eighth 5-Year Plan.

Key Projects Listed

91FE0525B Beijing RENMIN RIBAO OVERSEAS
EDITION in Chinese 12 Apr 91 p 4

[Article: "China Will Continue Attacking Key S&T Problems, Topics in Eight Areas Will Be the Focus"]

[Text] China plans to continue attacking key S&T problems during the Eighth 5-Year Plan.

During the Seventh 5-Year Plan, over 90 percent of the state key S&T problem contracts decided upon in China were completed.

Based on arrangements made in the National Economic and Social Development 10-Year Plan and the Eighth 5-Year Plan Outline, the focus of attacks on key S&T problems during the Eighth 5-Year Plan will be:

1. For agricultural technology, the focus will be on breeding improved varieties of crops and cultivation technology, comprehensive improvement technology for moderate and low-output fields, crop disease and pest prevention technology, livestock and aquaculture technology, farm product storage and processing technology, forestry engineering technology, and so on.

2. For resource exploration, the focus will be on systematic research on the oil and gas resources of Tarim Basin, prospecting and research for East China Sea gas fields, research on subsequent non-ferrous metals resource base areas on the Jinsha Jiang, Nen Jiang, and upper reaches of the Lancang Jiang in southwest China and in the Xinjiang region, and so on.

3. For development of large sets of equipment, the focus will be on 20 million ton-grade large strip mining equipment, 600MW nuclear power generators, 500 kV DC power transmission and transformer equipment sets, heavy-load train car equipment sets, 30,000-ton ethylene equipment sets, and so on.

4. For energy resource technology, the focus will be on stable output and high output technology systems for east China oil and gas fields, fully mechanized coal

mining and safe production technology systems, clean coal burning technology, new dam types and dam construction technology for hydropower, 200MW nuclear heating reactor engineering technology, new energy resource conservation technology, and so on.

5. For communication technology, the focus will be on railroad operation management and control technology, railroad high-speed passenger transport technology, new locomotive technology, high-grade highway and roadway materials technology, civilian aircraft navigation communication, space communication management systems and operational management technology, commuter aircraft design and manufacturing technology, interior river shipping channel dredging equipment and new ship model technology for interior rivers, and so on.

6. For raw materials technology, the focus will be on a shift to domestic production of a large variety of chemical catalysts, coal chemistry industry technology, oxygen-coal intensified smelting technology, non-ferrous metals energy conservation and comprehensive utilization technology, energy conservation technology for the contractual responsibility materials industry, fire-resistant materials manufacturing technology, and so on.

7. Microelectronics and emerging technology.

8. For other technology, the focus will be on population control and superior quality births and reproduction technology, new disease prevention technology, pollution prevention technology, water and soil conservation technology, major and frequent natural disaster monitoring and forecasting technology, and so on.

Emphasis on Basic Research

91FE0525C Beijing RENMIN RIBAO OVERSEAS
EDITION in Chinese 12 Apr 91 p 4

[Article: "China's High-Tech Research Has Arranged Special Projects That Will Push Forward Together With Basic Research in the Natural Sciences"]

[Text] Over the next 5 years, China's high-tech research and basic research in the natural sciences will push forward alongside each other.

In the area of high-tech R&D, based on arrangements in the National Economic and Social Development 10-Year Plan and Eighth 5-Year Plan Outline, the state will arrange several special research projects in biotechnology, information technology, automation technology, new energy resource technology, new materials technology, aerospace technology, and other fields. Among them, a portion will have to produce experimental prototypes, target products, or important stage achievements; some will have to make breakthroughs in key technologies, complete laboratory research, and produce properties prototypes or enter intermediate testing; and some projects must track the leading edge of high-tech and reduce the distance we lag behind advanced world levels.

The Eighth 5-Year Plan Outline stipulates that in the area of basic research in the natural sciences, the focus over the next 5 years will be on research on topics with important applications prospects in opening and emerging technology realms or in other technical fields, topics that will help foster China's energy resource advantages, and leading edge projects that are very important for strengthening self-development in S&T and that are the most lively in the modern era. The main ones include basic research on high critical temperature superconductivity, research on structure, properties, molecular design, and equipment manufacturing for photoelectric functional materials, research on climate dynamics and climate forecasting theories, research on large-scale scientific and engineering computer theory and methods, research on modern computer science and technology based on quantum physics, basic research on utilizing the advantages of male sterility hybrid advantages for grain, cotton, and edible oil crops, research on forecasting and countermeasures for future living environment change trends in China, and so on.

The arrangements in this plan were made on the basis of rapid development of S&T during the Seventh 5-Year Plan. During the Seventh 5-Year Plan, China made a total of 14,139 national-level S&T achievements, including state approval of 846 invention awards, 237 natural science awards, and 2,330 S&T progress awards, and there were 44 state key laboratories which were completed and passed examination and acceptance.

Protection Regulations for Software

91FE0525D Beijing RENMIN RIBAO OVERSEAS
EDITION in Chinese 3 Apr 91 p 3

[Article by reporter Liu Shaolin [0491 1421 2651]: "China Adopts Measures To Protect Intellectual Property Rights, Computer Software Protection Regulations To Be Promulgated, Creating the Conditions for Developing the Software Industry, Promoting International Economic and Technical Cooperation"]

[Text] I learned from the Ministry of Machine-Building and Electronics Industry on 2 Apr 91 that China will soon promulgate and implement "Computer Software Protection Regulations".

An official in the Ministry of Machine-Building and Electronics Industry said promulgation of these regulations will provide legal protection for copyrights over Chinese and foreign computer software.

He said that the Computer Software Protection Regulations were formulated on the basis of actual conditions in software development in China and on the basis of the "Copyright Law of the People's Republic of China" and in accordance with international law. Foreign software registered with China's software registration organs will receive effective protection.

Implementation of software copyright protections can improve the social environment in China's software

industry, provide developers with investment initiative, and prevent plagiarization of the achievements of others. It also can reinforce international cooperation, promote the absorption of advanced technology from foreign countries, and widely and profoundly promote computer applications.

He said that China can take advantage of its abundant resources and great export potential under a prerequisite of providing mutual and equivalent protection for software between countries to allow Chinese software to compete internationally and make China a software exporting country.

Indications are that China will make a considerable effort to strengthen software development and market administration during the Eighth 5-Year Plan (1991-1995) by establishing registration, arbitration, and enforcement organs to protect the legitimate rights and interests of software developers and create an excellent legal environment for development of China's software industry.

He said that for quite some time, intellectual property rights over software had not been respected and that the true value of software was not a point of concern to people, particularly with the appearance of plagiarized software over the past several years that has severely blunted their enthusiasm for developing software products.

He said protecting software property rights has now become an intellectual protection issue and social issue that the state must resolve properly. This is also a hot issue in international economic relations. He feels that respecting and protecting the software property rights of others is the foundation of international cooperation and exchange.

He said that China has been paying greater attention to protecting intellectual property rights for several years. Starting in 1984, the state began to be concerned with legislative work to protect computer software and promulgated the "Technology Contract Law", "Patent Law", and "Trademark Law", which have played a substantial role in protecting software copyrights. Formulation of a separate software protection law would provide greater guarantees for software copyrights and help promote their exchange.

People's Courts at all levels in China has established intellectual property rights judicial offices that hear infringement and other types of cases, and more than 100 have been handled so far.

Electronics Industry To Get Boost

91FE0525E Beijing RENMIN RIBAO OVERSEAS
EDITION in Chinese 3 Apr 91 p 3

[Article by reporter Liu Shaolin [0491 1421 2651]:
"China's Electronics Industry Development Given

Prominent Status, Investments Increased, Preferential Policies Implemented, Advanced Technology Imported"]

[Text] China has given development of its electronics industry the status of a national strategy in a major effort to develop the electronics industry and increase the level of electronics technology applications in China's economy.

Minister He Guangyuan [0149 0342 6678] of the Ministry of Machine-Building and Electronics Industry told reporters in Beijing on 2 Apr 91 that the electronics industry is a leading industry in promoting modernization of China's industrial structure and that the state will create the conditions for rapid development and extended applications of the electronics industry over the next 10 years in investment allocations, technology development, equipment renewal, industrial policies, organizational management, and other areas. He said that China's achievement of the two objectives of doubling its GNP again by the end of this century and attaining the level of moderately-developed nations in per capita GNP by the middle of the next century cannot be guaranteed by relying on excessive consumption of materials and energy resources, nor can we achieve it by relying simply on expanding the scale of traditional industry. Instead, we should make reduced consumption and increased efficiency the basic principles of economic development. This requires relying on development of the electronics industry and increasing levels of electronics applications.

He said that in order to reduce our lag behind advanced world levels during this century in our electronics industry, proposals made in the National Economic and Social Development 10-Year Plan and the Eighth 5-Year Plan formulated at the beginning of 1991 affirmed the important status of the electronics industry in national economic and social development. Investments in the electronics industry will be substantially increased.

Based on the spirit of the "proposals", China will concentrate its forces over the next 10 years to develop investment-type electronics products centered on large-scale integrated circuits with computers as the main factor in a major effort to reinforce development of microelectronics technology, computers and software, and transducers and apply them throughout the national economy, actively utilize electronics technology to upgrade traditional industry, and promote growth in emerging industry. At the same time, China will also work hard on developing optical fiber, satellite, microwave, and other communications products and consumer electronics products to meet the requirements of developing production and improvements in people's living standards.

Recently, the State Council decided that during the Eighth 5-Year Plan the state will implement preferential policies in the area of taxation for developing four

high-tech products: integrated circuits, electronic computers, software, and program-controlled switchboards. This will effectively promote applications of electronic information technology in all sectors of the national economy.

Minister He Guangyuan indicated that China's electronics industry will continue to implement a policy of opening up, import advanced technology, and develop international cooperation to promote renewal and replacement of electronics products.

Measure To Ratify High-Tech, New-Tech Enterprises

91FE0525F Beijing GUANGMING RIBAO in Chinese
19 Mar 91 p 1

[Article: "State Council Approves Conditions and Methods for Ratifying High and New Technology Enterprises"]

[Text] The State Science and Technology Commission recently formulated regulations and methods for ratifying high and new technology enterprises in state high and new technology development zones and the State Council has approved these regulations and methods.

The scope of high and new technology designated by the State Science and Technology Commission on the basis of the current situation in world S&T development is microelectronics and electronic information technology, space sciences and aerospace technology, photoelectric science and electromechanical integration technology, life science and bioengineering technology, materials science and new materials technology, energy science and new energy resources, high-efficiency energy conservation technology, ecological science and environmental protection technology, Earth science and marine engineering technology, basic materials science and radiation technology, pharmaceutical science and biomedical engineering, and other new techniques and new technologies utilized on the foundation of traditional industry.

Based on the ratification conditions, high and new technology enterprises are knowledge-intensive and technology-intensive economic entities. High and new technology enterprises in development zones must be involved in one or more types of high technology and research, development, production, and administration activities of such products within the scope of the stipulations outlined above. They implement independent accounting, make their own administrative decisions, and are responsible for their own profits and losses. The responsible persons in enterprises are S&T personnel well-versed in enterprise product research, development, production, and administration who are full-time personnel of their enterprise. S&T personnel with educational backgrounds above the college level account for over 30 percent of the total number of enterprise employees. S&T personnel engaged in high and new technology product R&D account for over 10 percent of the total number of enterprise employees.

Expenditures on R&D for high and new technology and their products account for over 20 percent of the annual gross income of their enterprise. The gross income of high and new technology enterprises is usually income from technology and the value of output of high and new technology products is generally composed of the value of output from technical products and related technology trade. The total amount of income from technology and value of output of high and new technology products of high and new technology enterprises accounts for more than 50 percent of their annual gross income.

To establish a high and new technology enterprise, an application must be submitted to the high and new technology industry development zone office where it are located. After examination by the development zone office, they are approved by provincial or municipal science and technology commissions. The development zone office must conduct the examination of high and new technology enterprises within a specific period of time. Economically independent scientific research units under ownership of the whole people which have fully implemented examination and reduction of administrative professional expenditures according to state stipulations and meet the conditions can become high and new technology enterprises after examination and approval by the development zone office.

Preferential Policy for High-Tech, New-Tech Industrial Zones

91FE0525G Beijing GUANGMING RIBAO in Chinese
23 Mar 91 p 2

[Article: "State Implements Preferential Policies for High and New Technology Development Industrial Zones To Promote Rapid Conversion of S&T Achievements and Foster and Develop High and New Technology Enterprises"]

[Text] Not long ago, when the State Council decided to establish 26 high and new technology industrial development zones, it also approved the "Provisional Stipulations for Certain Policies Concerning National High and New Technology Development Zones" formulated by the State Science and Technology Commission and the "Stipulations Concerning Tax Policy for National High and New Technology Industrial Development Zones" formulated by the State Administration of Taxation and provided preferential policies for national high and new technology industrial development zones.

Based on the spirit in these two "stipulations", the main preferential policies enjoyed by national high and new technology industrial development zones are:

1. A 15 percent reduction in the collection of enterprise income taxes. For those which export more than 70 percent of their value of output during a year, collection of enterprise income taxes is reduced by 10 percent.
2. A 2-year exemption from income taxes starting from the year they go into operation and a 2-year exemption

from income taxes for newly-established Chinese and foreign joint investment enterprises starting from their first year of profitability. After the tax exemption period expires, enterprises having real tax problems can receive appropriate tax reductions and exemptions.

3. Bonded plants can be established in development zones and export products made by processing materials provided by foreign businesses can be exempted from import tariffs and import product taxes and added value taxes.

4. Export products from enterprises in development zones can be exempted from export tariffs (apart from those in other state stipulations) and those which import instruments and equipment that cannot be produced in China can be exempted from import taxes.

5. Rapid depreciation can be implemented for the instruments and equipment used to produce and develop new technology by enterprises in development zones.

6. For all the taxes turned over by enterprises in development zones, using 1990 as the base number, all additional increases over 5 years are to be returned to the development zones.

7. Commercial and technical personnel in enterprises in development zones can leave China more than once each year and the various procedures can be simplified.

8. Productive and administrative capital construction projects in enterprises in development zones can be selected for inclusion in their local fixed assets investment scale. The state will raised a specific amount of capital construction loans and capital construction scale each year for use in development zone construction.

Preferential Policy for Computers, Software, SPC Switchboards, ICs

91FE0525H Beijing JISUANJI SHIJIE [CHINA COMPUTERWORLD] in Chinese No 10, 13 Mar 91 p 1

[Article by reporter Liu Jing [0491 5464]: "Four Types of Products Including Computers Will Continue To Enjoy Preferential Policies"]

[Text] I learned from the relevant departments on 12 Mar 91 that the state will continue to implement preferential policies for four types of electronics products during the Eighth 5-Year Plan: integrated circuits, electronic computers, stored program-controlled (SPC) switchboards, and software. The State Ministry of Finance and State Administration of Taxation have already issued formal documents in this regard.

The information indicates that during 1991, 223 production enterprises will enjoy state preferential policies that will exempt them from added value taxes or business taxes and reduce their income taxes, 10 percent of their income from sales will be deducted as an R&D fund, they will be exempted from tariffs on key imports of

instruments and equipment, and so on. The amount of the preferences for these 223 enterprises may reach 245 million yuan during 1991. On the basis of summarizing experiences, the state has made new stipulations regarding concrete implementation of preferential policies: starting in 1991, an annual summary inspection will be carried out in units which receive preferential policies. Those which have met the conditions and have good results will continue to receive them, otherwise they will be eliminated. Dynamic management will be carried out and there will not be a consistent system over 5 years. At the same time, for several enterprises which formerly did not receive the benefit of preferential policies, those which are confirmed to have made rapid progress and have met conditions can receive approval for preferential policies after strict examination.

I learned that the state began implementing preferential policies in 1987 for these four product categories in 235 enterprises. By the end of 1989, the total preferential capital these units had accumulated exceeded 600 million yuan. These funds were used for successful development of new 2,400 products, purchasing over 4,300 pieces of scientific research and development equipment, and focused upgrading of 10 production lines. The value of output of the four types of products was up 2-fold over 1986. Output was up more than 1.5-fold over 1986, profits and taxes realized were up 1.8-fold over 1986, and product exports were up 13-fold over 1986. Continued implementation of preferential policies during the Eighth 5-Year Plan will certainly further promote development of China's electronics information industry.

Exploring S&T System Reform in Eighth 5-Year Plan

91FE0738A Guangzhou KEJI GUANLI YANJIU [STUDIES IN S&T MANAGEMENT] in Chinese No 3, May-Jun 91 pp 1-3

[Article by Ke Si [2688 1835] of the State Science and Technology Commission Integrated Department: "A Superficial Probe into Basic Ideas for S&T System Reform During the Eighth 5-Year Plan"]

[Text]

I. The Guiding Ideology for S&T System Reform During the Eighth 5-Year Plan

1. Based on the demands of the 13th CPC Central Committee, gradually push toward intensification of S&T system reform.

2. The primary task of S&T system reform is to solve the problem of the detachment of S&T from the economy.

3. S&T system reform and S&T development work must be closely integrated.

4. S&T system reform must be coordinated with economic, political, and all other types of reform.

5. In intensification of S&T system reform, we should be concerned with its continuity and succession.
6. Macro reforms and micro reforms should be synchronized.
7. Set limited objectives, make key breakthroughs.
8. Experiment and demonstrate, guide by examples.

II. Basic Ideas for S&T System Reform During the Eighth 5-Year Plan

Based on the above guiding ideology, the fundamental ideas for S&T system reform during the Eighth 5-Year Plan are the "one continuing, two promotions, and three strengthenings".

A. The "one continuing"—continuing to relax administrative policies for scientific research organs and S&T personnel.

1. Continue to relax scientific research organs, make them truly develop into research and development entities.

a. Continue conscientious reform of the allocation system, continually improve management methods for the technology contract system, fund system, and expenditure contractual responsibility system. Reduce scientific research business funds no later than 1993. Further perfect a set of financial, banking, and taxation policies to create more favorable conditions for reform and development in scientific research organs.

b. Continue supporting and encouraging scientific research organs to establish integrated technology, industry (agriculture), and trade technical economics entities or various types of technical development consulting and service companies, and strictly distinguish them from economic and commercial enterprises run by party and government organs. Reinforce management, correct administrative working styles, observe discipline and abide by laws. Summarize and explore mechanisms and conditions ranging from companies run by scientific research organs to research institutes run by companies.

c. While continuing to implement the institute director responsibility system, we should further reinforce the political nucleus role of the party in basic-level scientific research organs, reinforce democratic management, clarify the duties and rights of all, work in cooperation, and form a coordinated leadership system.

d. While further intensifying reform of operational mechanisms, we should start working on readjustment of the organizational structure of the S&T system, suggest programs and the corresponding measures, and organize their implementation in a planned and gradual manner.

e. Use legal, economic, and the necessary administrative measures to gradually induce separation and recombination of scientific research organs and enable different types of independent scientific research organs to find

their optimum place in national economic construction. Change the situation of creating barriers and detachment of scientific research, production, and education, establish socialized and systematized network systems.

f. We should continue sustained and stable development of civilian-run S&T organs, reinforce leadership and management, further straighten out property relationships and the relationships between responsibilities and rights, and protect their legitimate interests. Civilian S&T organs should become an important force in China's S&T system structure.

g. Improve S&T management levels in all categories of scientific research organs (including civilian-run S&T organs), gradually achieve a transition to systemization, standardization, and science.

B. Continue to relax S&T personnel management policies, create the environment and conditions for them to give full play to their talents.

a. Make motivating the initiative and creativity of existing S&T personnel and improving personnel quality an urgent task for relaxation of S&T personnel policies during the Eighth 5-Year Plan.

b. Make readjustments in the structure of personnel distribution based on the need to readjust the industrial structure and product mixes to adapt to economic, S&T, and social development requirements in the Eighth 5-Year Plan and on to the end of this century.

c. Form a new system for S&T personnel management in China. With a prerequisite of guaranteeing the skilled personnel requirements of key projects and key units, open up socialist personnel markets. Reform the assignment system, establish a job grade wage system. Implement a social security system that integrates the state, collectives, and individuals, and so on.

d. Establish a personnel circulation system. There should be clear constitutional provisions concerning the rights of Chinese citizens for freedom in job selection. Implement the corresponding reforms in the security system, residence system, and other areas, and use this to establish a personnel circulation system with true bidirectional selection.

e. Implement a qualifications testing system, perfect the job title and hiring systems.

f. Adopt several special policies to train a group of young advanced experts and scholars to carry over into the next century (especially policies regarding the return of students studying abroad to China).

B. The "two promotions"—promoting S&T progress in enterprises and promoting S&T progress in rural areas.

1. Promote S&T progress in enterprises to make them the main force in China's technological development and the main force in S&T investments.

a. Further clarify that technology development work in enterprises is an important part of the three-level deployment of China's S&T work and that technology development organs in enterprises are an indispensable part of the organizational structure of China's S&T system.

b. Establish and perfect the enterprise technology development and technology management system with responsibility by chief engineers under the leadership of plant directors (managers).

c. Enterprises, especially large and medium-sized enterprises and enterprise groups, should establish their own technology development organs within 1 to 2 years by absorbing existing independent scientific research organs, establishing their own, and other arrangements, and they should have the corresponding decision-making rights and strict management methods. On the basis of the characteristics of different industries, clarify the corresponding proportion of S&T personnel engaged in technology development work.

d. Enterprises should set aside no less than 1 percent of their gross sales volume as an enterprise S&T development fund. They should adopt effective measures to make enterprises the main force in China's S&T investments.

e. Formulate enterprise S&T progress examination indices, include them in the enterprise management contractual responsibility system, and provide the corresponding reward and punishment regulations.

2. Promote S&T progress in rural areas and spur the development of the rural commodity economy in which S&T serve as the pillar.

a. Conscientiously summarize and explore the formation and development laws of all types of S&T extension service models in China's rural areas, which means acknowledging their powerful vitality as well as the difficulties and problems that exist with them, and provide them with correct guidance to form a rural socialized service system with Chinese characteristics.

b. Make breakthroughs in the existing situation of creating barriers and restructure the rural socialized service system based on a comprehensive set of pre-production, production, and post-production services to achieve optimum resource deployments.

c. We should formulate a set of preferential policies which benefit development of the rural socialized service system and they should be included among the important orders of the day for leaders at all levels so that they are truly dealt with and concrete problems are truly solved.

d. Strengthen management of the rural socialized service system and make major efforts in post-production services. We must make continual innovations in technology development and step up to a new stage in internal management.

C. The three strengthenings—strengthen the consciousness of science and technology on the part of the entire party and all the people, strengthen investments in S&T, and strengthen macro coordination and control functions.

1. Strengthen the consciousness of science and technology on the part of the entire party and all the people, truly place S&T in the primary status of economic development strategies.

a. All levels of government and leadership should clearly establish the concept that S&T are the first forces of production so that economic construction is truly shifted onto the track of relying on S&T progress.

b. Establish technical economics consulting organizations, work regulations, and a legal system for major governmental policy decisions, achieve procedural and standardized decision making. Inspections should be made as to whether all levels of leadership are relying on S&T progress.

c. Establish a policy and legal system to ensure and promote S&T progress, such as the need for the "S&T Progress Law" and other important laws and regulations to appear on the stage.

d. Formulate an Eighth 5-Year Plan program for relying on S&T progress to invigorate the economy and an implementation program.

e. Create an excellent social environment that respects knowledge and respects talented personnel. Foster the initiative of over 80 percent of specialized personnel to achieve a basic solution to the problem of a "brain" inversion. Continually develop S&T progress and further improve S&T development capabilities.

f. Use S&T progress to spur economic and social development. Increase the proportional contribution of S&T progress factors to economic growth by an average of more than 2 percent a year, increase the output value of new technology as a proportion of our GNP by an average of more than 1 percent a year, increase foreign exchange earnings from new products and new technology exports at an annual rate of 10 percent, and effectively control population growth and environmental pollution.

2. Strengthen investments in science and technology, ensure reserve strengths for national economic growth.

a. First, we should implement state financial allocations to science and technology and strictly follow decisions of central authorities concerning reform of the S&T system to increase them at a rate higher than the regular growth in financial income.

b. Increase investments in S&T expenditures from state finances from the present level of about 0.8 percent to 1 to 1.5 percent by the end of the Eighth 5-Year Plan.

c. Establish S&T credit accounts in all banks and increase the scale of credit from the present 2.5 billion yuan per year to about 10 billion yuan.

d. Straighten out state (including central authorities and local areas) financial S&T allocation accounts and channels. There should be unified planning, unified management, and unified implementation of scientific research activity funds, the three types of S&T funds, scientific research organ capital construction funds, scientific research organ technical upgrading funds, all types of special-purpose allocations, and so on.

e. Increase scientific research capital construction investments and open up channels for single item accounts. There should be a substantial increase in scientific research capital construction investments during the Eighth 5-Year Plan and an obvious improvement in the working and living conditions of scientific research organs and S&T personnel.

f. Open up funding channels for updating equipment in scientific research organs and arrange for the required capital to raise testing levels of scientific research organ equipment and instruments.

g. Reinforce investments in enterprise technology development.

h. Take advantage of all channels to raise capital from the state (departments and local areas), collectives, individuals, and foreign countries, expand capital sources, and establish all sorts of S&T development funds to ensure stable funding support for all S&T plans.

3. Reinforce macro coordination and control functions, take advantage of the integrated management functions of S&T administrative departments at all levels.

a. Establish policymaking leadership organs at all levels of government composed of the primary responsible persons in economic, S&T, financial, banking, taxation, education, and other departments, unify the formulation of major strategic principles, policies, plans, and laws to promote the coordinated development of the economy and S&T to truly form overall advantages for state S&T progress.

Reinforce coordination and control measures in the areas of planning, capital, materials, technology imports, digesting and absorbing, and so on in S&T administrative departments at all levels of government, fully foster their set of administrative functions toward S&T work, increase the utilization benefits of manpower, finances, and materials.

b. Further clarify the administrative functions and duties of S&T management departments at all levels and straighten out the interrelationships among them and their relationships to other departments, and make them statutory.

c. Decisionmaking in S&T administrative departments must first of all become scientific and democratic.

d. Further readjust the proportions of capital and manpower inputs in the three levels of development work, properly coordinate the relationships among various types of plans, and foster the overall advantages of S&T plans.

e. Based on the characteristics of each type of plan, formulate a set of relatively strict and scientific management systems and review and inspection systems, import competitive mechanisms, increase the transparency of plans, foster the maximum social and economic benefits using limited inputs.

f. Strengthen management and supervision of S&T work, establish an S&T work supervision and guidance system.

Potential of Chinese Research Institutes Analyzed

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[FORUM ON SCIENCE AND TECHNOLOGY IN
CHINA] in Chinese No 4, 18 Jul 91 pp 32-35

[Article by Liu Mingwei [0491 2494 0251]: "Analysis of Development Reserve Strengths in Chinese Scientific Research Organs"]

[Text] This article uses basic data from S&T statistical yearbooks from independent research and development organs under ownership by the whole people under the jurisdiction of departments at the county level (abbreviated below as "scientific research organs") and above for the entire field of the natural sciences from 1986 to 1989 as a foundation for analyzing the development reserve strengths of China's scientific research organs over the past several years.

I. Current Situation

1. Investments in research and development activities have increased, but investments in basic research and applied research have been weakened. In 1986, scientific research organs in China as a whole conducted research on 92,479 topics. This number had risen to 115,462 in 1989, an average yearly increase of 7.68 percent. The number of personnel involved increased from 305,114 to 333,417, an average yearly increase of 3 percent. The proportion of personnel involved who were scientists and engineers increased from 61.76 percent to 69.24 percent, an average yearly increase of 3.88 percent. Funding inputs increased from 2.26 billion yuan to 4.51 billion yuan, an average yearly increase of 25.84 percent. These statistics show that there have been substantial increases, both in absolute and relative terms, in personnel and expenditures in research and development activities. In the areas of basic research and applied research, however, inputs have grown slowly and have even been reduced. Statistics indicate that from 1987 to 1989, the number of personnel involved in basic research projects declined from 17,829 to 16,398, an average yearly drop of 4.1 percent (there was a 17.87 percent decline in scientific research organs under the jurisdiction of local departments). Personnel involved in basic research topics as a proportion of personnel in all projects declined from 5.64 percent to 4.92 percent, an average yearly drop of 6.6 percent. The proportion of scientists and engineers involved in basic research dropped from 6.77 percent to 5.68 percent, an average yearly decrease of 8.4 percent. Funding for basic research dropped from 187.25 million yuan to 187.16 million yuan, an average yearly drop of 0.02 percent. Funding for basic research as a proportion of funding for all projects declined from 6.03 percent to 4.15 percent, an average yearly drop of 17.04 percent. The extent of the reduction for this item was greatest for research organs under the jurisdiction of the various departments of the Chinese Academy of Sciences [CAS], from 4.31 percent to 2.46 percent, an average yearly decrease of 24.45 percent. For applied research, the number of personnel

involved increased from 57,846 in 1987 to 61,120 in 1989, an average yearly increase of 2.79 percent. The proportion of personnel involved in applied research among personnel involved in all topics rose from 18.30 percent to 18.33 percent, an average yearly increase of 0.08 percent. With the exception of a small increase in CAS institutes (3.79 percent growth), there were reductions in all research organs under the jurisdiction of the CAS and local departments (reductions of 1.3 percent and 4.5 percent, respectively). The proportion of scientists and engineers involved in applied research rose from 19.74 percent to 20 percent, an average yearly increase of 0.66 percent. Among them, there was a decline in research organs under the jurisdiction of local departments (from 8.32 percent to 7.66 percent, an average yearly drop of 4.05 percent). Expenditures on applied research increased from 579.08 million yuan to 845.14 million yuan and their proportion of expenditures on all projects rose from 18.64 percent to 18.73 percent, an average yearly increase of 0.24 percent). Among them, with the exception of institutes of the CAS which increased by 11.48 percent, there were 4.41 percent and 1.66 percent reductions, respectively, in research organs under the jurisdiction of the CAS and local departments. Personnel and expenditures for basic research and applied research as a proportion of personnel and expenditures for all projects declined at an average yearly rate of 1.45 percent and 3.70 percent, respectively.

2. S&T funding sources have expanded and expenditures have risen, but scientific research and development still lack reserve strengths. From 1986 to 1989, yearly income for all of China's scientific research organs (not including expenditures on capital construction) increased from 8.79 billion yuan to 14.69 billion yuan, an average yearly increase of 18.67 percent. Among them, government allocations increased from 4.92 billion yuan to 5.73 billion yuan, an average yearly increase of 5.23 percent. Horizontal technical income increased from 1.63 billion yuan to 4.59 billion yuan, an average yearly increase of 41.2 percent. Government allocations as a proportion of yearly income dropped from 55.97 percent to 39.02 percent, an average yearly drop of 11.33 percent. The proportion for horizontal technical income rose from 18.55 percent to 31.25 percent, an average yearly increase of 18.99 percent. Over the same period, yearly outlays and expenditures at scientific research organs (not including expenditures on capital construction) rose from 8.04 billion yuan to 13.27 billion yuan, an average yearly increase of 18.16 percent. Internal outlays used directly for scientific research activities rose from 7.88 billion yuan to 12.74 billion yuan, an average yearly increase of 17.38 percent. Among internal outlays, growth was greatest for scientific research business costs and management costs, from 3.27 billion yuan to 6.32 billion yuan, an average yearly increase of 24.65 percent. Because scientific research organs can accumulate little capital, scientific research and development still lacks reserve strengths, which is manifested in:

a. Rising scientific research costs. Growth in expenditures has basically maintained a balance with outlays and there is very little surplus. Over the past few years, average per capita expenditures and outlays have risen at an annual rate slightly higher than per capita income. The reason is that, besides a significant increase in scientific research activities, rising materials prices are a major factor behind the rising costs in scientific research organs. Statistics show from income in scientific research organs (including government allocations and their own horizontal income) and their outlays, there was a per-person surplus of -90 yuan in 1986, 350 yuan in 1987, 60 yuan in 1988, and 200 yuan in 1989. In the structure of outlays, business costs and management costs accounted for about one-half of internal outlays while labor costs accounted for about 20 percent. Although the absolute rate of growth in this amount was lower than the rate of growth in funding income, continually rising scientific research costs made it very difficult for scientific research organs to have surplus funds.

b. Funds to purchase scientific research instruments and equipment have declined each year. Scientific research instruments and equipment are fixed assets and an important indicator which reflects the development reserve strengths of scientific research organs. Statistics show that outlays in scientific research organs to purchase and build fixed assets as a proportion of total internal outlays have dropped precipitously at a 15.38 percent yearly rate. Among them, outlays to purchase scientific research instruments and equipment have dropped at an average rate of 15.73 percent a year. Capital construction funds, which mainly come from state inputs, declined from 2.263 billion yuan in 1986 to 2.249 billion yuan in 1989, an average yearly drop of 0.59 percent. Funds for purchasing scientific research instruments and equipment as a part of capital construction expenditures have declined abruptly at an average yearly rate of 19.16 percent, dropping from 529 million yuan in 1986 to 284 million yuan in 1989. The actual rate of decline in funds to purchase instruments and equipment has been far greater than the extent of rising prices for materials. As scientific research personnel and scientific research activities grow, it has become increasingly obvious that there are insufficient funds for scientific research instruments and equipment.

3. There has been a trend toward declining research levels in scientific research organs and theoretical research has been weakened. Statistics show that from 1987 to 1988, the number of achievements from all of China's scientific research organs that received awards dropped from 11,082 to 9,843, an average yearly reduction of 5.76 percent. The number of achievements that received state-level awards declined from 567 to 479, an average yearly drop of 8.09 percent, while the number of achievements which received provincial and ministry-level awards dropped from 6,499 to 5,649, an average yearly decrease of 6.77 percent. Among them, the degree of the reduction in achievements receiving awards was greatest for organs under the jurisdiction of the CAS, at

9.42 percent. Organs under the jurisdiction of the CAS also saw the fastest reduction in achievements receiving state-level awards, at 13.13 percent. For achievements receiving provincial and ministry-level awards, the decline was fastest for organs under the jurisdiction of local departments, at 7.21 percent. To exist, many scientific research organs have begun shifting toward "short, easy, and fast" development projects in their selection of scientific research tasks and the result has been a decline in scientific research levels and a weakening of theoretical research. Statistics show a 0.58 percent reduction from 1987 to 1988 in the number of scientific research articles published. There was a 0.54 percent reduction in the number of articles published in foreign countries. Articles published in foreign countries as a proportion of all articles declined from 12.92 percent in 1988 to 11.67 percent in 1989. Scientific and technical works translated into foreign languages as a proportion of all works declined from 4.04 percent in 1987 to 3.12 percent in 1989, an average yearly drop of 12.12 percent. There was also a 6.01 percent drop in the total number of scientific and technical works from 1988 to 1989.

II. Analysis and Conclusions

1. Provision of scientific research funds is only at the "warm and well-fed level" and inadequate reserve strengths for scientific research development will affect reinforcement of China's S&T strengths. As mentioned previously, since China's implementation of reform of the S&T system, expanded funding sources for scientific research organs have increased per person gross income by an annual rate of more than 18 percent, so it should be stated that there have been improvements in the situation of severely inadequate funds. However, because of the effects of increased scientific research activities, rising scientific research costs, and other factors, the increased income actually has been washed away by increased outlays and the various types of direct funding that truly go for scientific research activities in scientific research organs are barely enough to use, so they are only at the "warm and well-fed" level. In this type of situation, most scientific research organs still lack the capacity for self-development and their limited earnings cannot be used to purchase all the advanced instruments and equipment, so they must continue to rely on state allocation channels. However, the degree of increase in government allocations for S&T is far below the rate of growth in our GNP and the substantial reduction in funds for purchasing fixed assets has led to serious aging and inadequacy of scientific research instruments and equipment, which has brought about backward scientific research means that make it hard to adapt to the development of high and new technology and hard to make more high-level research achievements. In another area, reform of the S&T allocation system has forced many scientific research organs to run around seeking ways to make money for their very existence, so they are not concerned with key state projects and basic research work which they have inadequate funds to take on and

which is difficult, involves long schedules, poses risks, and provides few benefits. They are willing to take on technology development and technical service projects that are short, easy, and produce quick results, but they are unwilling to take on projects to attack key problems. Added to reduced arrangements in plans for basic research project personnel and funds, the increased funds have mainly been used for non-basic research and applied research projects, which has caused a loss of coordination in the proportional relationships among the inputs in each category of research activities. Expenditures on research and development in China as a proportion of our GNP in 1988 show that the strength of China's investments in R&D are already lower than the levels seen in Japan during the mid-1950's, South Korea in the late 1970's, and India in 1987. This shows that China is lagging even further behind the economically-developed nations and certain developing nations in this area. If we do not immediately make readjustments in this situation, it will affect the international status of China's S&T strengths. Moreover, it will affect smooth development of China's future economic construction.

2. There are not enough matching policies for reform of the S&T system and the psychological capacity of S&T personnel is weakening, and these have affected stability in S&T staffs. The central question in reform of the S&T system is promoting integration of S&T and the economy. It should be said that through various types of efforts over the past several years, there are many applied technical achievements from scientific research organs that have flowed toward the first line of production, which has greatly spurred development of economic construction and produced rather good benefits. We cannot fail to note, however, that the actual income of scientific research organs from technology transfers as a proportion of their total horizontal income has tended to decline (dropping from 16.43 percent in 1986 to 10.81 percent in 1989, an average yearly reduction of 13.03 percent). Many enterprises are still relying mainly on expanding the scale of capital construction and importing new production lines for expanded reproduction and lack the motive force and capacity for relying on S&T progress to develop production. Added to the difficulty of scientific research organs participating in digesting and transplantation of technology imports and technical upgrading in old enterprises, and to the serious deviation of the prices of S&T achievements from their value, scientific research organs are no longer capable of obtaining the necessary economic benefits solely from technical income. One reason for this situation is that the state lacks matching policies to stimulate enterprises into using S&T achievements and a second reason is that unceasing reductions in business funds and the collection of various types of taxes have increased the burdens on scientific research organs and restricted increases in public accumulation in scientific research organs. Statistics indicate that since 1986 all categories of taxes, funds, and allocations to higher authorities from scientific research organs have increased from 300 yuan per person to 580 yuan per person, an average yearly

increase of 24.58 percent. Everyone knows that the basic guiding ideology for reform of the S&T allocation system is full control of allocated funds and total deregulation of policies, but there is now full control of funds while matching total deregulation policies have not kept pace. This has restricted the transition in some scientific research organs from a simple scientific research arrangement to a scientific research and administrative arrangement, which has affected their technical services and economic incomes, and there have been continual reductions in public accumulation as a result as well as a weakening of the psychological capacity of S&T personnel. Moreover, in the area of reform of the personnel system, factors related to a lack of matching policies have also damaged the initiative of S&T personnel who do have the capacity and pushed them into the ranks of circulating personnel. In conjunction with the serious phenomena of unfair social distribution and the "brain inversion" and low treatment of S&T personnel, many young S&T personnel are unhappy with their jobs or have left China, or they are looking toward jobs in "enterprises with three capital sources" [foreign capital, overseas Chinese capital, and Hong Kong and Macao capital] which offer higher incomes, better treatment, and opportunities to go abroad and looking toward coastal regions. Statistics show that from 1986 to 1989, the proportion of personnel involved in S&T activities as a part of all employees declined from 74.71 percent to 74.06 percent, an average yearly drop of 0.29 percent. Personnel listed on the job rolls of project groups as a proportion of all personnel engaged in S&T activities dropped from 56.04 percent to 52.40 percent from 1987 to 1989, an average yearly drop of 3.3 percent. It is apparent that important manpower resources, a reflection of scientific research and development reserve strengths, have been weakened and that this has affected the stability of S&T staffs.

3. Operational mechanisms in scientific research organs are incomplete and short-term behavior is continuing to intensify. At present, among the various management systems implemented in scientific research organs, although the cadre term of office objective responsibility system has eliminated the lifelong cadre system, there are no clear examination standards and examination methods for the objectives and responsibilities during the term of office, so it is easy for cadres to give insufficient attention to scientific research and development reserve strengths during their term of office (such as ignoring technical reserves, etc.). During the process of implementing an S&T contractual responsibility management responsibility system, a situation is often created in which S&T personnel pursue "short, easy, and fast" projects because of excessively detailed contractual responsibility indicators, excessively burdensome economic indicators, and other factors. This even includes many elderly experts and scholars. In this type of situation, several key projects assigned by the state are inevitably attacked, which worries personnel who assume responsibility for such projects. At this time, simply resorting to the elementary management method

of rewards and punishments to motivate the initiative of S&T personnel in scientific research organs is no longer effective. Such irrationality in operational mechanisms not only exacerbates short-term behavior in scientific research work and prevents assurances of the quality of scientific research, but also means that S&T work lacks extensive deployments and long-term considerations, preliminary research work cannot be undertaken, technical reserves are exhausted from day to day, and scientific research organs have basically lost their development capabilities.

III. Countermeasures and Proposals

1. The state should increase investments in S&T and especially should increase the proportion of investments in R&D activities and key state projects to enable stable development of S&T activities. Developing S&T is a major matter that concerns China's progress in modernization and the prosperity or decline of our nationality. Given the serious problems described above, the state should substantially increase its funding for purchases of advanced scientific research instruments and equipment as part of capital construction in scientific research organs to ensure improvements in scientific research conditions and environments and help scientific research work track world developments in new and high technology. To ensure the integration of S&T and the economy, the state must increase its funds for R&D activities and key state projects to attack major problems. It should also provide policy protections to enable S&T to be the vanguard in production and practice and prevent a detachment of scientific research from production and obstruction of the development of economic construction because of backward S&T. China is now in the initial stages of developing industrialization and it should be stated that this type of input must be slightly greater than the rate of increase in our GNP to be able to ensure progress in the development of industrialization in China, which is essential for reducing China's lag behind the economically developed nations.

2. Create an excellent external environment for scientific research organs to strengthen their own development vitality and power. We must re-evaluate and acknowledge essential differences between scientific research organs and enterprises, try to open channels as quickly as possible, and formulate and implement matching policies. We should ensure that all of society and especially enterprises are concerned with and promote mechanisms for reliance on technical progress to increase economic benefits and reverse the situation in which technical knowledge and software achievements do not deserve funding. We should use policies to guide and lead enterprises to rely on China's S&T forces to develop production and we should formulate tax reduction and exemption policies concerning enterprise applications of S&T achievements and enterprise investments in R&D activities to increase investments in S&T and promote the conversion of S&T achievements into forces of production as quickly as possible. We should readjust finance and tax policies for scientific research organs to

increase public accumulation in these organs and strengthen their self-development capacity.

3. Perfect operational mechanisms inside scientific research organs, correctly deal with the relationship between vertical and horizontal tasks, and make good deployments in depth to ensure development reserve strengths for scientific research organs. The operational mechanisms inside scientific research organs directly affect the initiative and productivity of S&T personnel. There must be quantitative evaluations of all objectives during the terms of office for cadres and long-term plans should be used to decide upon the various indices during the terms of office of cadres to prevent short-term behavior. Implementation of a contractual responsibility administrative responsibility system cannot simply involve contractual responsibility for economic indicators. It should also include concern for assessments of scientific research levels and technical reserves and concern for fostering overall advantages to prevent a situation in which everyone goes around looking for money because contractual responsibility for results has been too detailed. We should ensure the completion of tasks in state plans and contractual responsibility policies should provide preferences for assuming contractual responsibility over vertical scientific research tasks and ensure the scientific research conditions and individual incomes for those tasks. Leaders of scientific research organs should make good deployments in depth, ensure the investment proportions for long-term objectives, actively undertake preliminary research work, and be concerned with technical and capital reserves for scientific research development reserve strengths. During the process of implementing various types of contractual responsibility administrative responsibility systems, we should ensure that funds are used mainly for scientific research activities, avoid excessive outlays for non-scientific research and production, and "milk" scientific research funds that are insufficient in the first place.

Vice Minister Delivers Keynote Address at Fiber-Optic Communications Conference

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[CHINA ELECTRONICS NEWS] in Chinese
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[Unattributed article: "Zeng Peiyan Delivers Speech on Development of Fiber-Optic Communications"]

[Summary] At the Fifth National Fiber-Optic Communications Conference, convened 17 May in Tianjin, Vice Minister of Machine-Building and Electronics Industry Zeng Peiyan delivered the keynote address, in which he remarked how the new-technology revolution, led by microelectronics and information technologies, has driven international economies and technical industries. The Party Central Committee and the State Council, having observed developmental trends in world economics and technologies, have decided to earmark the electronics industry as a breakthrough area for further development of high-tech as a whole, the minister

observed, and fiber-optic communications is a critical area in the development of the electronics industry. Through absorption of imported technology, a domestic fiber-optic communications industry centered on three cities—Shanghai, Tianjin, and Wuhan—has grown up, and has mastered production technology for DS4 [140 Mb/s, 1,920 voice circuits] fiber-optic communications equipment, with DS5 [565 or 622 Mb/s, 7,680 voice circuits] equipment now in the laboratory-testing stage. Compared to developed nations, however, China is still significantly behind.

In the Eighth 5-Year Plan, he stressed, the nation needs to break down the barriers between government and industry, regulate the industrial structure, and adjust the product mix. Also, the requisite manpower, material resources, and finances must be concentrated—according to market demand—on the technological transformation of industrial and research units and on the organization of production economies of scale.

While emphasizing that the further development of China's fiber-optic communications industry must be founded on self-reliance, he added that the nation must simultaneously continue to import, absorb, apply, and recreate the best of advanced foreign technology. In terms of funding, he urged that the nation set aside a fixed percentage of its assets to cover importing of foreign technology.

Finally, the vice minister discussed how other industries—those involved in manufacturing of telephones, teletypes (telexes), FAX machines, radio transceivers, pagers, digital program-controlled [telephone] exchanges, TVs, and VCRs, for example—and consequent economic benefits have resulted from the application of microelectronics technology in developed nations.

Lessons From Gulf War: Strengthening of Electronics Industry Seen Crucial

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[Article by Ouyang Wen [2962 7122 2429] of the Standing Committee of the National People's Political Consultative Conference and advisor in the former Fourth Ministry of Machine Building Industry: "The Gulf War Shows the Importance and Urgency of Strengthening Construction of China's Electronics Industry"]

[Text] Article 21 of the CPC Central Committee's "Proposals Concerning the Formulation of the 10-Year Program for National Economic and Social Development and the Eighth 5-Year Plan" points out that "the electronics industry is a leading industry which promotes modernization of China's industrial structure" and makes a decision to "give development of the electronics

industry a prominent status" and to "create the conditions in all areas including capital allocation, technological development, equipment updating, industrial policies, organizational management, and so on over the next 10 years for rapid development, extension, and application of the electronics industry". This decision of the CPC Central Committee is extremely correct and wise and it follows historical developments and world currents.

From the overall situation of the world's economic development and military development, the electronics industry has become a strategic industry in today's world. Like the "two bombs" [atomic and hydrogen], it has truly become a new indicator of the status of a great nation. Electronic technology is the most advanced force of production and an important military strength in the modern age and it has very powerful dispersivity and permeability. It is becoming an increasingly indispensable thing in a modern economy and national defense and even in social life. Those who grasp advanced electronics technology and who have a strong and solid electronics industry are those who grasp the power of initiative in economic development. A common experience in the successes attained in economic development in many countries has been accelerated development and widespread application of electronic information technology. The outcome of the Gulf War confirms from another vantage point the importance of electronic technology in modern economic and military development.

The 42-day Gulf War was a unique high-tech electronic war. Leaving aside political, economic, religious, and other factors, the multinational army led by the United States was able to achieve military victory with few losses. I feel that electronics technology played the key role in the war. Overall, it had five characteristics: 1) A variety of powerful electronic jamming measures were used to blind Iraqi radar, disrupt communications, render photoelectric sensors useless, cause a loss of control over weapons, destroy command flexibility, remove the army's capacity to fight, eliminate control over the air for tactical air attacks and the subsequent ground war, and smoothly provide the decisive conditions. 2) Over 20 satellites fitted with advanced electronics technology and equipment, all sorts of surveillance aircraft, and over 30 ground-based electronic monitoring stations were used to form an omni-bearing, three-dimensional surveillance network in space, in the air, on the ground, and under water that was capable of synchronized observation of Iraqi military movements and changes in defense works, and it provided accurate data on the changing war situation and for conducting sea, land, and air attacks. 3) All sorts of photoelectric guided weapons have become the basic firepower of war and greatly increased the hit rate of firing. The use of electronic night vision technology guaranteed the ability to fight in all weather. It was stated that the hit rate of "Tomahawk" missiles was greater than 90 percent. The success rate for interception of "Scud" missiles by "Patriot" missiles was also very high. 4) Airplanes had a

very powerful fighting capacity and could attack ground and air targets in all weather and all directions with high precision. Moreover, they carried defensive electronic warfare systems that greatly increased the capability to exist of the aircraft themselves. 5) Electronic warfare command systems functioned at remote distances, had powerful command capabilities, and were capable of accurately and rapidly command and guiding actual attacks by aircraft. They also coordinated the activities of air and ground forces and could foster the overall combat effectiveness of this war involving many countries, a variety of troops, and many types of machinery and weapons. In summary, the Gulf War has made us soberly take notice that military equipment centered on electronics has dramatically changed the tactics and technology used in modern warfare and that the role of high-tech equipment in war has been greatly increased.

Reviewing construction of China's electronics industry, under the concern and leadership of the party and government, although we have made considerable progress since the nation was founded and especially in the past 10 years, we still lag substantially behind advanced international levels and face an extremely serious situation. For the most important foundations of the modern electronics industry, integrated circuits for example, our production levels are roughly equivalent to those of the developed nations in the mid-1970's and we are three stages behind in technical development. Overall, our electronics industry has a small scale, scattered forces, few investment-type products, and a weak capacity for supplying equipment. If we fail to change this backward situation, it will inevitably have serious effects on China's progress in national economic modernization and construction and will affect achievement of our second and third strategic goals for development of our national economy. It will be like when China had no atomic bomb, no hydrogen bomb, and no petroleum and we will be in an extremely passive condition. In particular, it will seriously obstruct strengthening and improvement of our military equipment and will directly affect our national security. Many historical events have told us that "backwardness implies vulnerability!". I offer these suggestions for quickly spurring China's electronics industry forward:

1. Establish a concept of modern warfare, clarify the strategic status of the electronics industry, place electronics and information technology at the strategic heights of national security, concentrate manpower, materials, and finances, mobilize and organize forces in all areas, make systematic arrangements and deployments for applications, markets, technology, industry, the environment, and so on, take the whole country into account, work in full cooperation and with unity of purpose, and join forces in struggle.

2. We should quickly formulate articles for invigoration of the electronics industry and make them into legal stipulations for the development objectives, focus points, measures, conditions, and so on for the next decade for our electronics industry, and carry them out

for our benefit. In another area, we should formulate electronic product application and equipment policies, preferential support policies for several items, import encouragement policies, policies to provide appropriate protection to our national industry, national electronics and information industry management policies, and so on. We should use legal restrictions and policy guidance to promote widespread application of electronic technology in all spheres and guide construction and development of the electronics and information industry.

3. Straighten out the management system, foster the industrial functions of electronics industry management mechanisms. This is particularly true for the high-tech electronics industry. We certainly must concentrate forces, implemented centralized management, unify leadership, and strive to foster enthusiasm in all areas to the maximum extent possible.

4. I hope that the state will make appropriate increases in capital inputs for construction of the electronics industry. In particular, it should increase investments to establish microelectronic technology and computers and in the military electronics industry and provide support for all areas. We should be clear that in the future, with the approval of the state, no department or region should increase the number of integrated circuit manufacturing plants or take the old route of all areas of the country producing color televisions.

5. On the basis of the need to implement a 10-year program for development, we should formulate principles and policies for personnel training, reinforce construction of electronics colleges and schools, and strengthen our specialized technical staffs. To concentrate forces and attack key S&T problems, we should implement wage subsidy policies for skilled personnel in key departments. Adopt special measures to entice personnel who have gone to study in foreign countries to return to China and contribute their strengths to development of China's electronics industry.

6. Reinforce military electronics scientific research and give preference to developing important military electronics equipment that is urgently needed by the military. In development, we should give special attention to dealing properly with the relationship between importing advanced international technology and relying on our own efforts and to achieving full integration and matching up of various types of weapons and equipment, especially development of electronic countermeasure and information and command equipment, which should be given an extremely important status.

Implementation of Electronics Industry S&T Development Plan Ratified

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[CHINA ELECTRONICS NEWS] in Chinese 14 Jul 91
p 3

[Article by Chen Rushu [7115 3067 3219]: "Ministry of Machine-Building and Electronics Industry Approves

Implementation of the Eighth 5-Year Plan Electronics Industry S&T Development Plan"]

[Text] The Ministry of Machine-Building and Electronics Industry has approved the "Eighth 5-Year Plan Electronics Industry S&T Development Plan" and will begin implementing it in 1991. The primary content of this plan includes two parts. One is an outline and the other is a key project plan. The outline portion is focused on proposing the guiding ideology, strategic objectives, key S&T tasks, and policy measures for developing electronics industry S&T during the Eighth 5-Year Plan. The key projects plan is compiled according to major categories. The scientific research portion contains 42 major categories with a total of 401 projects. The product development portion contains 50 major categories with a total of 883 projects.

This plan is a guidance-type document for S&T development in the electronics industry during the Eighth 5-Year Plan, and it serves as the basis for the formulation of the state's various directive-type S&T plans for the electronics industry and will be implemented through a variety of channels in S&T plans of state ministries and commissions, local areas, enterprises, and industries. The main aspects of the plan outline include:

I

The plan outline begins with service to national economic construction and national defense construction by the electronics industry, key project progress, product development, and levels of a shift to domestic production, the S&T development system, staff construction, and other areas and outlines achievements in S&T work in the electronics industry during the Seventh 5-Year Plan. It points out that since reform and opening up, the electronics industry has made nearly 20,000 scientific research achievements through attacks on key S&T problems, technology importing, technical upgrading, and technology extension and that several of these achievements have approximated or attained advanced world levels. Many achievements have made major contributions to national economic and national defense construction and improvements in the people's material and cultural lives. Through reform and readjustment, S&T work by scientific research units in the electronics industry is now gradually orienting itself toward the industry and key backbone enterprises and enterprise groups have begun to focus on new technology and new product development, which are now developing into the main battlefield of S&T work in the electronics industry.

The plan outline summarizes the main discrepancies and problems in S&T work in the electronics industry. The main discrepancies and problems are:

1. Basic technology (electronic components technology, special purpose electronic equipment, electronic measurement instruments technology, special purpose electronic materials technology, processing techniques and technology, and so on) has developed slowly and is at a low level.
2. The product design and development and innovation capacity is poor, performance, quality, product variety, and reliability levels are low, there are severe shocks from imports, the scope of applications is narrow, and technical services are weak.
3. The problems of insufficient state investments in electronics S&T and organizational management have led to low-level repetition and dispersion in electronics scientific research work and our scientific research levels lag further behind foreign countries. R&D on production and engineering technology and progress in the conversion of S&T achievements into commodities has been slow.

II

The plan outline proposes that, with microelectronics technology as a foundation and computers and information technology as representatives, electronics S&T are the most rapidly developing and most intensely competitive vanguard technologies among modern high technology. The development and widespread application of electronics technology is now spurring new structural changes in our national economy and national defense system. Electronics technology has already become the most advanced and most vigorous force of production in modern society and it has turned the electronics industry into a leading industry that is promoting modernization of our industrial structure. Thus, as a strategic and tactical resource, the level of electronics technology and its industry have become a major indicator of a country's technical, economic, and national defense strengths and its ability to participate in international competition.

The development characteristics of the world's electronics technology at the present time are:

1. A continually accelerating speed of technical innovation. New technology and new products are emerging continuously and prices have dropped substantially.
2. Production and engineering have developed quickly and broadly. Computer-aided technology has permeated the entire production and engineering process, there have been continual reductions in the existence schedule of product design, production technology, equipment, and instruments, replacement is accelerating, and management is continually being perfected.
3. Production of knowledge is continuously expanding. Knowledge production (that is, soft technology production) has now penetrated every link of scientific research, production, circulation, service, and application in the

electronics industry. There has been a continual expansion of soft technology production and a continual reduction in the proportion of hard technology production.

4. Integration of industrial development is becoming increasingly close and advanced electronics technology is now turning the electronics industry into a technology-intensive industry with rapid product renewal and replacement, high added value, good economic benefits, and more export foreign exchange earnings.

5. Permeation of and integration with the economic, social, and other realms has intensified and this has led to increasingly profound changes in S&T, society and the economy, and human life, and it has continually opened up new realms for electronics S&T and its application.

6. It is a key technology for reinforcing national defense strengths and promoting integration of the military and civilian sectors. The transfer of military electronics technology to civilian uses and improvements in the level of civilian electronics technology are constantly blurring the boundaries between military electronics technology and civilian electronics technology.

7. The government has been paying greater attention. Government coordination via policies and organization of major electronics technology projects by adopting stronger investments, concentrating forces, coordinating battles, making integrated attacks on key problems, and focusing on breakthroughs have brought about a constantly changing development deployment of a new era of technology, a new era of products, and a new era industry in electronics technology and its industry.

Given the status and characteristics of electronics technology, the basic ideas behind China's "Eighth 5-Year Plan Electronics Industry S&T Development Plan" are:

1. Invigoration of the electronics industry must rely on S&T progress.
2. The main battlefield in electronics S&T work is technical upgrading in the national economy, modernized construction of national defense, and improving the people's material and cultural living standards.
3. Truly foster the vanguard role of electronics technology and its industry, continually provided advanced and applied technology and equipment to promote modernization of China's industrial structure and S&T.

III

The plan outline clearly proposes strategic objectives and overall tasks for development of S&T in the electronics industry during the Eighth 5-Year Plan.

The strategic objectives are: raise overall S&T levels in the electronics industry, strengthen close integration of scientific research with production and S&T with the economy, readjust the industrial structure, improve the quality of products, increase economic benefits, reduce

the adverse balance of imports and exports, strengthen digestion and absorption of imported technology, increase our capacity for self-development and market competition, reduce our lag behind advanced international levels, make major efforts to promote the application of electronics technology in all industries and sectors, continually use electronics technology to upgrade traditional industry, strive to promote technical progress in the electronics industry and all of society, serve the promotion of China's four modernizations drive and raising the people's material and cultural living standards, and serve the strategic objective of increasing the gross output value in the electronics industry eight-fold and quadrupling the gross value of industrial and agricultural output by the end of this century.

The overall tasks are:

1. Lay a technical foundation for establishing China's electronics high-tech industry which is led by microelectronics technology, based on basic electronics products and technology, and represented by computers, information, and consumer electronics goods.
2. Use research on large-scale production technology as the main direction of attack, rapidly absorb and grasp advanced foreign technology, increase our capacity for self-development, accelerate the conversion of S&T achievements into commodities and industrialization, and increase the competitiveness of Chinese electronics technology and products in domestic and foreign markets.
3. Focus on electronics equipment and systems applications projects, reinforce scientific research work for military electronics, and strive to transfer military electronics technology to serve construction of the national economy.
4. Focus on medium and long-term research on major topics with directional properties to reinforce the development reserve strengths of China's electronics S&T and its industry. Concentrate forces and organize preliminary research and attacks on key S&T problems at different levels in key fields that have a major impact on our economic construction and national defense construction, use tasks to guide disciplines and use systems engineering to guide products to extend and apply achievements from projects to attack key S&T problems in key projects and key equipment.

The primary aspects of the development objectives for electronics industry S&T during the Eighth 5-Year Plan are:

1. Focus on technical progress in an effort to increase the proportion of investments in electronics products from 15 percent in 1990 to about 25 percent.
2. Rely on technical progress for 60 percent of the increase in output value in the electronics industry.
3. Focus on levels in the electronics S&T field that approximate or attain levels in the developed nations of

the early and mid-1980's. Overall electronics S&T strengths should approximate levels in the developed nations of the late 1970's and early 1980's.

4. The average yearly renewal rate for product varieties of electronics products should reach 20 to 25 percent. On the basis of the number of S&T achievements completed during the Seventh 5-Year Plan, increase them by 25 percent each year. The number of applied achievements and achievements that can be converted into commodities should be increased by 10 percent and 5 percent, respectively, compared to the Seventh 5-Year Plan.

5. Use continued technical progress to support the achievement of our development goals for the electronics industry, the national economy, and national defense construction.

a. Achieve computer-automated control of 50 percent of our electronics industry production technology and equipment, reduce the equipment renewal schedule to 8 to 10 years. Strive for greater than 50 percent domestic production of key special-purpose electronics equipment and measurement equipment and for a production technology and equipment development capacity at international levels of the early and mid-1980's.

b. Form an electronics functional materials and special purpose electronics materials industry.

c. Develop automated design and production technology focused on microelectronics, computers, information, and software, promote the "achievement of a second transition" in the electronics industry.

d. Develop and produce 50 percent of the electronics equipment in China that is needed for technical progress in the national economy, national defense construction, scientific research, and other realms.

6. Construction investments and scientific research expenditures for research in developing electronics industry S&T should account for 3 to 5 percent of the gross output value of the electronics industry and development expenditures for primary products should account for more than 5 percent of the enterprise sales volume.

7. Make industry construction and development the center, use reform to further readjust electronics S&T forces and deployments, concentrate on key technical fields and primary products in the electronics industry, establish several industry R&D centers, production engineering research centers, and technical service centers, foster the role of main armies in attacks on key S&T problems, technical development, and production technology research for major fields that have significant impacts on development of the national economy and the electronics industry.

8. Establish a rather high level S&T staff matched to specializations and disciplines that has participated in electronics industry scientific research, development, manufacturing, application, marketing, and service.

IV

On the basis of the strategic objectives and development principles for electronics S&T during the Eighth 5-Year Plan, the "Eighth 5-Year Plan Electronics Industry S&T Development Plan" proposes 38 key S&T tasks in the 12 key electronics S&T fields of integrated circuits, electronic computers and peripherals, computer software and applications technology, information equipment, radio and television broadcasting equipment, new types of electronics parts and components, new electronics materials, special-purpose electronics equipment and large-scale production technology, electronic measurement instruments and electronic medical equipment, electronic systems equipment, military electronics technology, and electronics industry standardization and measurement. It selects 1,284 primary projects as the focus of electronics scientific research and new product development during the Eighth 5-Year Plan. Most of them are items for exporting to earn foreign exchange, replace imports, conserve energy and materials, and serve technical upgrading in traditional industry and technical progress in all sectors of the national economy. Some are preliminary research projects to prepare development reserve strengths. Completion of these tasks will require organization of enterprises, research institutes, and institutions of higher education to carry out attacks on key S&T problems and technical development at different levels for key technologies to attain advanced international levels of the 1980's.

Telecommunications: Adapting to New Needs

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[Article by William P. Wang]

[Text]

Part I: The Market for Telecoms Equipment

Just as in the West, a thorough analysis of the telecommunications market in China can be a complex exercise. The market in China can be considered in terms of geographic segments (urban versus rural), end-users (institutional versus individual), or types of equipment. The most straightforward approach is to look at the market in terms of equipment type.

Public Telephone Switching Equipment

Public or central office switching equipment is the big ticket item. This is the area where Chinese equipment manufacturers are the least competitive technologically, and has attracted the most attention among the major foreign telecommunications equipment manufacturers.

Although China has made great strides in expanding telephone services since the mid-1980's, it is still very much a frontier market. The average nationwide telephone density is a mere 1 per 100 individuals. Ninety

percent of the telephone exchanges are still electro-mechanical cross-bar and step-by-step switches. Some rural areas still use handcranked telephone terminals, and many rural areas have no telephone service at all.

Most improvements to the telephone services have been in the major urban centres. International direct dial services are available in all the major hotels and large office buildings, in addition, some public telephone booths also offer IDD services. Many more individuals have private telephones. These improvements have been due largely to the vast number of central office switches China has imported, and competition among the major foreign vendors for China sales has been fierce. Many companies provide China with "give-a-ways" such as paging systems and even mobile telephone systems in the hopes of gaining central office switching contracts of several tens of thousands of lines.

So far the leader in this race has been NEC, followed by Fujitsu, Ericsson, ITT/Alcatel, Siemens, AT&T, Northern Telecom and Plessey. In the past two years, the MPT has narrowed the field to three companies: Alcatel, NEC and Siemens. NEC and Alcatel have set up joint ventures to manufacture public switches in China, and Siemens entered into a licensing agreement to do the same. All three have also agreed to transfer integrated circuit technology to China. In return, China has put these three companies on the "short-list" of approved suppliers of central office switching equipment.

Although companies not on this list are not absolutely shut out of the market, they do indeed face a severe handicap in trying to sell central office equipment in China. An attractive finance package, either from the company, or soft loans from the home country of the vendor, can facilitate a decision to bend the rule of buying only from one of the three so-called approved vendors.

Most finance for purchases of large central office switches has been done using funds supplied by the state, or foreign loans—usually soft loans—provided by the government of the respective foreign vendor. This situation, however, is changing. The MPT, for example, provided about 45 percent of the total financing for telecommunications development in 1983 but only about 22 percent in 1987. More and more, the central government is requiring the local PTT's to finance their own equipment purchases either through service fees, locally borrowed funds such as bank loans, or issuance of bonds.

Private Branch Exchange Equipment

The market for private branch exchanges (PBX), unlike central public telephone switches, is fragmented and not controlled by any particular bureaucracy. The only requirement is that end-users register their equipment with the local PTT's. Ten joint ventures have been established to manufacture PBX equipment for the domestic market. However, China still imports a considerable amount of PBX equipment as well.

End-users are large hotels, government organizations, major enterprises and other large institutions. In addition, some localities, especially rural regions, use PBX equipment to serve as small local public switches which are then linked to the regional trunk lines. This "quick fix" allows local regions to get telephone services on an end-node basis relatively quickly rather than wait for installation by the local PTT.

Mobile Telephone and Paging System

Mobile telephone and paging systems, estimated already to exceed 300,000, are fast developing markets in China. Market segmentation with respect to end-users is clear. The largest group of end-users are law enforcement bureaus (local police and armed police), customs, military, forestry, and transportation, including the railways and inland water routes and ground support at the major airports.

Another group of end-users is the rapidly growing number of entrepreneurs, the individual dealmakers who travel the country. In the West, mobile telephones and paging systems are sometimes viewed as mere gadgets—convenient, but not essential. However, in China mobile telephones may represent the only practical means of communications. Public telephones in China are few and maintenance on them is haphazard. Although the situation has improved significantly in the large urban centres, it is not always possible to get a clear, open line on immediate demand.

In some conditions, mobile telephones may also represent a faster way to provide telephone service to remote regions, especially where geographical conditions make it difficult and expensive to install wired lines. Although mobile systems may be more expensive per line than hard wire telephone systems, the time delay and added expenses in laying down lines in rough terrain may in some cases persuade local telephone operators to choose mobile telephones over traditional telephones. Indeed, a full cost comparison, including the opportunity cost of not having telephone service at all may show mobile telephone systems to be a viable economic alternative to wired telephone service.

Microwave

Over the past decade, China has not put much emphasis on the use of microwave for trunking operations, concentrating instead on installing thousands of kilometers of wire, as well as optical fibre trunk lines. Microwave has not developed as rapidly as hard wire transmission, mainly because of the relatively low technology base in China, and the restrictions imposed by COCOM on the kinds of microwave technology that can be exported to China.

The major end-users of microwave systems include the MPT, Ministry of Radio and Television, Ministry of Railways, and various departments and agencies

involved in power generation, water conservation, petroleum exploration and transportation, the PLA and the Bank of China.

Satellite Telecommunications

This is another area destined for rapid expansion. Because the Chinese population is spread over vast land masses with extreme variations in climate and terrain, satellite telecommunications are often more ideal for telecommunications transmission than microwave. But, like microwave, the level of domestic technology does not match the highest international standard, even though China does have several domestically designed and manufactured telecommunications satellites in service.

As in other scientific disciplines, in the past the Chinese have tended to emphasize theoretical or academic expertise, and apart from ground antennas where practical expertise is high, lack practical experience in the design, manufacture and operation of sophisticated satellite systems.

Facsimile and Telex

Telex machines are in wide use in China, but facsimile machines are rapidly overtaking telex as the preferred means of data communications. While telex transmissions offer more clear transmissions, facsimile can transmit handwritten graphics and messages, which telex cannot. Chinese characters, both handwritten and typed, can be transmitted by facsimile which is of considerable convenience to Chinese users.

Most imported facsimile machines are from Japan, but an increasing number of units are being manufactured in China using imported production lines. Most of these factories are under the MMEI, with a few under the Ministry of Aeronautics and Astronautics.

Summary

China's telecommunications plans for the coming decade are truly ambitious. The Eighth Five-Year Plan (1991-1995) calls for the expenditure of at least US\$7 billion for further development of the telecommunications system. Both domestic and foreign funds will be utilized to lay down another 20,000 kilometers of optical fibre trunk lines and 10,000 kilometers of digital microwave trunk line and to manufacture, as well as import, additional large-capacity program-controlled telephone switches.

Despite China's enormous requirements for telecommunications equipment and technology, it is clear that China intends to rely less on the import of technology and equipment, and more on domestic production. Already, three major joint ventures have been established to manufacture large central office telephone switches. Ten joint ventures exist for the manufacture of PBX equipment. It is not inconceivable that China may

eventually become a major exporter of facsimile and peripheral equipment for the telephone industry.

In order to remain competitive, foreign companies must be prepared to view the China market in terms of long-term investment and not merely as an export market for their hardware and technology.

Part II: The Organization of Telecoms Equipment Manufacturing

As one gains more familiarity with the commercial environment in China, the picture gradually emerges that the socialist principle of production for the common enterprise—the socialist state—holds little truth in actual practice.

Chinese enterprises and factories are as competitive as any in the capitalist West. "China watchers" and foreign businessmen often criticize China for the resources which are wasted because of duplication of effort among enterprises or research institutes (as well as government bureaucracies) when they fail to share information and resources.

The basis of such criticism, especially by foreign companies, is often due to their inability to find a single source of information about the current market situation in China, or about finding the "right" Chinese partner for a joint project—both of which are the natural result of trying to do business in a highly complex and dynamic market.

As government subsidies dwindle, factories are being forced to fight for their very economic survival. They must rely more on their own inventiveness to turn out saleable products rather than on blindly producing according to state plans. As is the case with their counterparts in the West, they are just as disinclined to share the fruits of their R&D with competitors—even factories within the same ministry.

Under the MPT there are 28 major factories and many other research and manufacturing affiliates managed by the PTIC. Through the PTIC, the MPT exercises relatively tight control over these factories. The PTIC is responsible for coordinating the activities of these factories and supervising their annual production to prevent industrial fratricide within the MPT community.

In the MMEI "family" are 18 major factories and over 1,000 affiliated factories. In contrast to the MPT, MMEI exercises much less control over the factories with regard to management and production, and competition among these factories is intense.

State Versus Non-State Projects

Unlike the situation ten years ago, when all foreign investment was strictly controlled by the central government, foreign companies today have many more ways to develop investment projects in China, some of which may not involve the central government at all.

State Products: "Top-Down"

As economic reforms gradually take hold in China and more sectors of the economy are allowed to come under market forces, it is becoming more difficult to generalize about the Chinese economy. Certain industries, like steel, oil and coal production, agricultural production, power generation and water are still strictly controlled and heavily subsidized by the central government. Other industries on the other hand, particularly certain sectors of light industry are not controlled at all. Other industries, notably telecommunications and electronics, fall somewhere in-between the almost free market situation of certain light industrial sectors and the centrally controlled heavy industries.

Manufacturers of small peripheral equipment like telephone handsets, many of which are assembled by rural collectives, are subject to little government control except for conformance with operational standards. Large infrastructure projects with strategic importance to the overall economic welfare of the nation are strictly controlled by the central government. These projects include central office telephone switching equipment and the manufacture and import of key electronic components or subassemblies for such equipment.

Most of these projects are developed through a "top-down" process, where, for example, the planning departments within the MPT may conceive of a project to manufacture large public telephone switches in China, in order to reduce reliance on imports and develop the technological and manufacturing capabilities of the MPT factories. Following review and approval, the MPT will submit the project to the SPC for inclusion in the state plan. Approval by the SPC also qualifies the project for central government financing.

Some major long-term projects must be approved by the State Council, in which case central government financing will usually be available. If the project was developed in the planning departments of the SPC itself, an intense battle will likely develop between the MPT and MMEI to be the designated ministry to carry out the project.

If technology is to be imported, tenders, requests for quotations and the like will be issued by the China National International Tendering Corporation (CNTIC) or another designated import/export corporation to those foreign companies who are known to have such technology. In other cases, foreign companies may learn of the project through their respective contacts in China, such as representative offices or agents and approach the MPT or MMEI with a proposal to participate.

Such top/down, state-approved, state-funded projects may be equity joint ventures (Alcatel and NEC—central office switching projects), contractual joint ventures, technology transfers such as licensing agreements (Siemens—central office switching project), or the outright purchase of foreign technology. One key feature of state approved projects is that imported technology, parts,

components, or prototype equipment are imported duty free, or at significantly reduced rates.

Tax holidays or reduced rate of tax will normally be available and the foreign vendor or partner will be guaranteed foreign exchange at official exchange rates with respect to royalties or the repatriation of income. The production from such projects are guaranteed a domestic market because designated end-users will be allocated funds to buy the equipment. In most cases the venture (normally the foreign party to the venture) will also be required to export some of the production in an attempt to balance the venture's foreign exchange accounts, but in actual practice if the project is of strategic importance, strict adherence to this requirement is infrequent, especially if the project represents genuine import substitution.

State Projects: "Bottom-Up"

Situations may arise where projects are formulated and developed at the factory level and submitted to higher government levels for approval and funding. The factory may lobby the ministry to which they report to have the project included in the ministry's plans.

The ministry may fund the project out of its discretionary development funds or submit the project to the SPC for inclusion within the list of state projects. In the end, bottom-up projects classified as state-approved and state-funded projects, are no different from projects developed from the top-down.

However, if the project is approved only at the ministry level, it may still be classified as a "state-approved" project, but the chances of receiving full state funding (SPC approved funding)—or any state funding—are slight. The ministry may assist in finding the finance for such projects, but ordinarily the Chinese parties rely on the sale of the production and the foreign participant for financing.

Frequently, confusion exists in differentiating between "state-approved, state-funded" and "state-approved but not state-funded projects", particularly when project negotiations take place when the scope or definition of the project has not yet been completely defined. The project may be approved in principle at the ministry and SPC levels, or even the State Council level. Yet, the details regarding the scope of the project and its funding may still be unresolved, because of competition at the SPC and State Council from other ministries, provinces and regions with their own "critical" funding demands.

In such cases, the Chinese party in the negotiations may not know the actual classification of the project even though it has authority from the ministry (and perhaps the SPC as well) to discuss formally the project with potential foreign partners. Indeed, the Chinese party—as well as perhaps the foreign party may be required to conduct considerable high level lobbying for the project. As is frequently the case, the success of these kinds of

bureaucratic manoeuvres depends on the political influence and stature of the ministry promoting the project.

Non-State Projects

Increasingly, the government is encouraging enterprises and factories to develop and finance their own projects based on market conditions. However, many factories are reluctant to take these measures for fear of failure. These projects receive no financial support from the government. The factory must raise the funds to finance the project, develop or acquire the necessary technology, set up the production facilities, and market the production.

Historically, factories took their production orders from the central or local government agency responsible for that particular industry. Furthermore, production and marketing have historically been separate activities in China. Factories responsible for production merely concerned themselves with production, other enterprises were responsible for distribution of the production. Marketing terminology is only beginning to come into the commercial vocabulary of Chinese factories and enterprises.

Foreign companies may directly approach individual factories to develop projects. But the foreign company must have solid information about the potential Chinese partner—its management style and technical capabilities or else considerable time may be wasted with the “wrong” Chinese partner.

The principal handicap of non-state projects is that imported technology, parts and components receive no preferential customs treatment. In addition, there is no guaranteed domestic market for the production and the venture must balance its foreign exchange, either through export sales or foreign exchange transactions in the currency swap market. Tax breaks, however, are usually still available since the tax laws does [as published] not discriminate between state approved and funded projects and non-state projects.

Even under these handicaps, with the “right” Chinese partner, profitable projects can be developed that actually out-distance state supported projects. Such projects will be smaller in scale than state supported projects because of the hardships of self-financing and higher customs duties for imported parts and technology.

Local Government Supported Projects

The local government post and telecommunications bureaus (PTT) and machine and electronics bureau function similarly as their respective central government agencies, and in some cases, local and central government jurisdiction over a particular factory or enterprise may overlap. Developing projects with local government cooperation can sometimes be a feasible alternative to developing project at the central government level.

Local, usually provincial government agencies, will have factories directly under their control, for example, the local bureau of MMEI may be called the Ministry of Machine and Electronics Bureau and have a factory directly under its control called the Ministry of Machine and Electronics Industrial Corporation. However, unlike the relationship between the central government ministries and centrally controlled factories, the relationship between local ministry bureaus and locally controlled factories can be very tight. The director of the local bureau may be the president, or a high ranking manager of the local factory.

To overcome this bureaucratic handcuff, some local bureaus establish corporations, often merely holding companies with the local factories as subsidiaries and assign (at least part-time) key personnel from the bureau to manage the corporation which itself is permitted to develop projects and carry out manufacturing. These kinds of structures are more common within MMEI than MPT which exercise relatively tight control over the local ministry bureaus and factories.

It is generally easier to obtain local government project approval when dealing with these kinds of local quasi-government bureaus/industrial corporations, because the local government bureau may have a direct stake in the financial outcome of the project.

Projects officially approved and funded at the local government level may be granted preferential treatment with regard to local customs duties and local taxes. The local government will also help to promote the sales of the products within the province and also assist with sales outside the province as well. But projects approved solely at the local level will normally receive little or no support from the central government.

Part III: Telecoms Market—Structure and Policy

With a population of over 1.1 billion and an average nationwide telephone density of about 1 for every 100 persons, China is undeniably the world's largest market for telecommunications equipment and services.

Despite the country's chronic shortage of hard currency and the reputed difficulty in doing business there, some of the major manufacturers have found the China market lucrative. NEC, for example, has sold over 880,000 lines of switching equipment to China. And as one of three designated foreign suppliers of public telephone switching equipment, NEC stands to reap additional profits as China plans to install over 33 million additional lines of switches by the end of the decade.

The China telecommunications market, however, is no place for faint-hearted companies or those looking for quick profits. Competition is fierce and aggressive pricing is the norm. Corporate strategies are based on long-term positions. In some countries of Southeast Asia, telephone switching equipment suppliers return home with contracts signed at US\$400 per line. In China they are happy if they bring home one-half that amount.

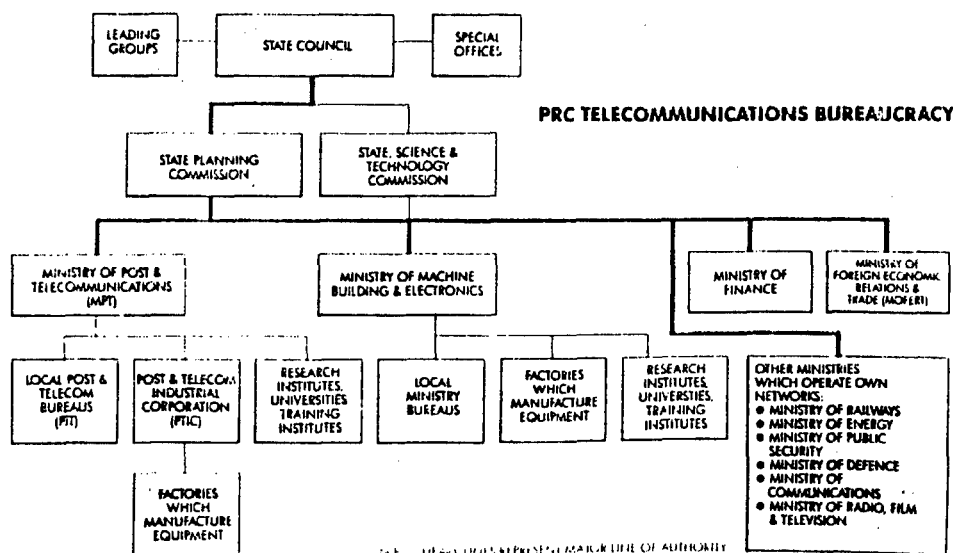


FIG. 1. THE ABOVE REPRESENTS THE HIERARCHY OF AUTHORITY

China fully understands that a well-functioning telecommunications system is critical to economic modernization. China also recognizes that its own technology lags far behind that of the West. The overloaded and outdated switching devices and analog transmission systems of the Chinese telephone network simply cannot handle the high speed, high volume data and voice transmissions of modern economic societies. In order to achieve the stated goal of a national average of 2.8 telephones per 100 persons by the end of this decade, China will indeed have to import huge amounts of telecommunications equipment and technology.

Government Bureaucracies in Charge of the Telecommunications Industry

There is a widely held belief, that because China is a socialist country, all economic activity from the formulation of macroeconomic five-year plans and the allocation of raw materials, to the handing down of detailed production directives to individual enterprises and the setting of prices, is controlled by the central government, and that all enterprises and factories function harmoniously to produce for the overall economic benefit of society.

While central government officials in Beijing may indeed want to see such a situation, the fact is it does not exist. China is far too vast a country to be so strictly controlled by the central government.

What is more, central government agencies whose roles are to coordinate overall industrial and commercial activity within the economy, often have overlapping portfolios and compete against each other for funding and the authority to develop projects. Foreign companies trying to gain a better understanding of the market situation in a particular industry often find themselves caught in a bureaucratic web as they shuttle between ministries and agencies, each purporting to have "sole"

authority over the industry. Compounding the bureaucratic disharmony of the central government is the consistent failure of local governments to strictly adhere to the economic directives issued by Beijing, preferring instead to establish their own economic priorities.

In many respects, the telecommunications industry typifies the general situation in China. The industry is complex, highly competitive, and equipment manufacturing is splintered between two long-time ministry rivals: the Ministry of Post and Telecommunications (MPT) and the Ministry of Machine Building and Electronics (MMEI). Both have jurisdiction over funding and development of telecommunications equipment manufacturing projects. Other ministries and agencies, such as the railways, military, radio and television, energy resources, and law enforcement agencies operate, as well as finance, their own dedicated communications networks.

Because there is no single path into the telecommunications market in China, foreign companies intending to sell telecommunications equipment or invest in this market have to concern themselves with numerous ministries and agencies both at the central and local level, even though as in many other countries, telecommunications services in China are controlled by the MPT and the local post and telecommunications bureaus (PTT) under the MPT.

Central Government Administration Over Telecommunications

At the top of the central government hierarchy is the State Council, comprised of the premier, vice premiers, ministers and state councillors. Under the State Council are the special purpose organizations; the leading groups, commissions, ministries, offices, agencies (bureaus) and administrations.

Leading groups provide comprehensive coordination over several industries or disciplines. The commissions with slightly higher stature than ministries also provide broad coordination over industries which may overlap two or more ministries. Ministries, offices, and administrations are responsible for specific industries or activities.

Commissions

The State Planning Commission (SPC), the most important and powerful agency in central government, is responsible for national economic planning and the allocation of state funds. Within the SPC, the departments of Long Term Planning, Science and Technology, Fixed Assets Investment, Technological Renovation, Utilization of Foreign Funds as well as the General Department of Finance are directly involved in the review and approval of telecommunications projects. The Department of Regional Economic Planning of the SPC is responsible for the coordination between central government projects and local projects.

The State Science and Technology Commission (SSTC) is the other commission-level government agency involved in telecommunications. The role of the SSTC, however, is limited to the allocation of funds for telecommunications research and development. The SSTC is also responsible for scientific and technological exchanges between China and other countries.

Ministries

The two ministries with portfolios in telecommunications are bureaucratic rivals in the telecommunications industry. The MPT, with its monopoly of long distance and local telephone service, is the primary user of telecommunications equipment. MMEI, on the other hand is the primary manufacturer of telecommunications equipment, in particular, components for telecommunications equipment.

MPT, however, through the Post and Telecommunications Industrial Corporation (PTIC), manufactures much of its own equipment, especially switching equipment. The PTIC itself was formed in the mid-1980's when the Science and Technology Department and the Industrial Department in the MPT were separated from the ministry and separately organized to take over direct responsibility for manufacturing.

The bureaucratic rivalry among the central government agencies has actually led to increased decentralization of the planning and funding process in the telecommunications industry because both the MPT (through PTIC) and MMEI, as well as the other ministries that operate their own communications networks, compete amongst each other for manufacturing projects. Each ministry with its "wish list" of projects lobbies for SPC approval. Indeed the SPC is often confronted with situations that to appease the competing ministries, especially the MPT and MMEI, it must divide up projects. A clear example is the plum of all telecommunications projects: central

public switch manufacturing. MPT has one joint venture in Shanghai with Alcatel while MMEI has received approval to set up two joint ventures—one in Beijing with Siemens and another with NEC in Tianjin.

Other ministries with a lesser role in the telecommunications industry in China are the Ministry of Finance (MOF) and the Ministry of Foreign Economic Relations and Trade (MOFERT). The MOF allocates the funds approved by the SPC for specific programs and projects, monitors the actual use of such funds and evaluates the overall performance of these projects. The MOF also has substantial influence over the actual use of loans from international funding agencies such as the World Bank and the Asian Development Bank. Not to be reckoned too lightly, a poor evaluation by the MOF may lead to reduced project funding in subsequent years or difficulty in obtaining additional funding for project expansion.

MOFERT is primarily responsible for the negotiation and signing of contracts involving the import of equipment, parts, or technology as well as for projects financed with foreign loans. One sign of the seriousness of the Chinese side in discussing the terms of a project with foreign companies, is when a team of representatives from MOFERT, or one of the major trading companies under MOFERT, appears at the negotiations with the technical and management team from MPT, MMEI or one of the ministries which operate dedicated communications networks.

Telecommunications Research and Development

Most research and development in telecommunications is carried out by the MPT and MMEI. The main research centres under MMEI are the No. 54 Research Institute in Shijiazhuang, the capital of Hubei Province and the No. 6 Research Institute in Beijing.

MPT carries research mainly through the No. 1 Research Institute in Shanghai, the No. 5 Research Institute in Chengdu, the No. 4 Research Institute in Xian, the MPT Scientific Research Institute in Beijing and the Wuhan Post and Telecommunications Research Institute.

China has a relatively strong telecommunications research base, but like most other disciplines, basic research dominates applied research—this in turn, results in a relatively weak technology base and product development. The situation is, however, changing as the central government gives freer reign to local level units, such as enterprise groups and individual factories to develop, manufacture and market products of their own design in an attempt to reduce the burden central government, as well as local government, has of continually subsidizing the operations of these enterprises and factories.

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and later practised law. Most recently, Mr. Wang worked in Beijing for five years as a legal consultant to the Ministry of Finance and the State Council Legislative Bureau. He assisted the former State Economic Commission (now merged with the State Planning Commission) with preparing project proposals and also helped identify appropriate foreign investors for projects in China. He edits a loose leaf service of the official English translations of the Chinese tax laws and tax related investment regulations concerning foreign businesses and individuals.

Establishing Electronic Ceramics New Materials Enterprises Urged

91FE0738B Beijing ZHONGGUO DIANZI BAO
[CHINA ELECTRONICS NEWS] in Chinese
28 Jun 91 p 3

[Article by Jinghua Radio Equipment Plant director Cheng Debao [4453 1795 0202]: "Accelerating Construction of Electronic Ceramics Industry Groups Can Brook No Delay, China's Small but All-Inclusive Electronic Ceramics Industry Not Favorable for Development"]

[Text] Electronic ceramics are newly emerging ceramic materials that come in many types, the main ones including high heat conductivity insulating ceramics, semiconductor ceramics, magnetic ceramics, microwave ceramics, photoelectric ceramics, and others. Their production and development have provided electronic overall system products with several unique new types of components with excellent properties.

For the past several years, the international electronic ceramics industry has developed extremely quickly. Projections indicate that the annual sales volume of electronic ceramics in Japan will increase at a 9.4 to 14.8 percent yearly growth rate from 1987-2000. Examples include Murata and Kyocera, whose sales volumes reached \$800 million and \$2 billion, respectively, in 1985, making them the world's leaders. Siemens, Toshiba, and Matsushita, the international magnates of the electronics industry, have also established their own electronic ceramics R&D organs and manufacturing base areas in order to have their own special reliable sets of parts and components.

I. The Current Situation in China's Electronic Ceramics Industry

China's electronic ceramics enterprises have also developed very quickly. During nearly 10 years of reform and opening up, several enterprises have used technology imports and technical upgrading to remain the backbone of our electronic ceramics industry. Many emerging enterprises, especially electronic ceramics enterprises along our coastal region, have made use of their own advantages and risen up. Institutions of higher education and scientific research units have become a central force in the field of research on electronic ceramics materials. Statistics for 1989 indicate that the annual volume of

sales in China's electronic ceramics industry reached about \$100 million, so it has formed a definite scale.

However, in the larger international environment, China's electronic ceramics industry is obviously small but all-inclusive, weak and scattered. There are many disadvantages to being small but all-inclusive which restrict development of China's electronic ceramics industry. First, being small but all-inclusive precludes the formation of scales and forestalls raising a wave. China's biggest electronic ceramics enterprises have a yearly sales volume of less than \$10 million whereas Murata, Kyocera, and other companies in Japan have volumes in the several \$100 million to several \$1 billion range. Our capacitor ceramics, piezoelectric ceramics, and magnetic ceramics fall far short of the requirements of scale economies and are unable to take their place among the world's most powerful. Second, being small but all-inclusive means poor levels of specialization. Smaller enterprises must go through a full set of work procedures and measures beginning with preparing materials, molding them, firing them, assembling, testing, analyzing, and so on. This is especially true of work procedures for raw materials preparation which create widespread pollution, add to control problems, and restrict expansion of the scale of production. Third, because they are small but all-inclusive and have a poor degree of specialization, the results they provide are also poor. Fourth, in a situation of being small but all-inclusive, every enterprise must establish its own development organ, and it is impossible to outfit them with the important theoretical analysis and microscopic inspection means that are involved in producing and building ceramic materials. This leads to slow development of new products and makes improvement in quality levels difficult. Thus, although China's electronic ceramics industry has a definite foundation and strengths, its current situation restricts further development and improvement of China's electronic ceramics industry.

II. New Challenges Facing the Electronic Ceramics Industry

During the Sixth 5-Year Plan and Seventh 5-Year Plan, Japan exported several production lines to China which moved our electronic ceramics industry a great step forward. However, just when these projects were playing their role and were about to squeeze into international markets, Japanese enterprises invested in building plants in Singapore, Malaysia, Thailand, and other countries, which constituted a threat to China's formation of "pincerlike advantages" and the entry of Chinese electronic ceramics products into international markets. They might even have affected our domestic markets. The recent merger of Japan's Kyocera Company and the United States' AVX Company will further strengthen the status of Japan's electronic ceramics industry in the world. This grim situation should attract attention in China's electronic ceramics industry.

What can we do? We must take the route of integration and the route of specialized large-scale production and scale economies, which means that there should be Chinese "Matsushitas" and "Hitachis", and we should establish Chinese "Muratas" and "Kyoceras".

III. Build Chinese Electronic Ceramics Industry Groups

Just about everyone in China has heard of Matsushita and Hitachi, but I doubt that many people in the electronics field are familiar with Murata, Kyocera, and TDK. Still, we should have our own "Murata Company" and "Kyocera Company", and we must certainly have our own electronic ceramics industry group.

Continual development and exploitation of unique new functions of electronic ceramics materials will enable the development and manufacture of a new generation of optical components. Application of these new components may even lead to revolutionary changes and developments in overall systems. For example, using ceramic duplexers in mobile communications can enable mobile telephones to be made into portable and hand-held models, something that cannot be done using other materials. Nevertheless, the current situation in China's electronic ceramics industry still makes it difficult to satisfy the requirements of this type of overall system development. The way out once again is taking the route of specialized large-scale production and establishing electronic ceramics enterprise groups.

IV. How Should We Establish Electronic Ceramics Enterprise Groups?

Establishing electronic ceramics enterprise groups requires implementing a specialized division of labor and in particular there is a need to centralize production of electronic ceramics materials and establish base area enterprises to produce several 100 to several 1,000 tons of powder each year. This would help tie together the relationships among enterprises which produce special-purpose materials used in the metallurgical, chemical, and electronics industries. It would help in the development and improvement of new materials, and it would benefit effective control of pollution.

Enterprise groups should use materials as a tap, appropriately and rationally optimize the product mix, and implement a specialized division of labor and cooperation. They should use legal, administrative, and economic measures to abandon several outdated, poor quality, and imitation products. The groups should establish their own scientific research and development organs and establish closer integration with institutions of higher education. Groups should establish their own employee education systems. They should establish powerful production rear-area guarantee systems.

Electronic ceramics fall into the scope of high technology, so we must transform traditional investment concepts and strengthen inputs.

It will not be impossible to establish several of China's own Muratas and Kyoceras through efforts during the Eighth 5-Year Plan and several years afterward.

Of course, as a component industry serves overall systems, overall systems can also be used as a tap to establish groups and turn them into materials and components service departments for overall system groups.

Defense Science Commission To Strengthen Investment in Electronics, Optoelectronics Technology

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[CHINA ELECTRONICS NEWS] in Chinese
22 May 91 p 1

[Article by reporter Yu Ruming [0151 3067 2494]: "National Defense Science, Technology, and Industry Commission Highly Concerned about Developing Electronics Technology, Will Implement Slanted Investments Focused on Key Projects, Nie Li [5119 0500] Stresses Need To Arrange and Organize Implementation To Elevate Electronics and Information Technology to the Heights of National Strength and Prosperity"]

[Text] "Electronics Technology is the foundation and the key, and all of China should pay more attention to developing electronics and information technology and should arrange and organize implementation to elevate it to the heights of national strength and prosperity." This statement was made by National Defense Science, Technology, and Industry Commission deputy chairman Nie Li during an inspection of Institute 44 in the Ministry of Machine-Building and Electronics Industry from 7 to 8 May 91.

Nie Li continually heard reports and after arriving at the research office to view displays of scientific research achievements and technical line operations, she held a meeting with several 10 engineering and technical personnel and listened to their suggestions concerning the question of developing national defense electronics scientific research. At the same time, she introduced experiences and lessons during the [Persian] Gulf War in the areas of using electronic warfare technology, optoelectronic and various types of intelligence gathering technology, and communication countermeasure technology. She expressed her satisfaction with the scientific research achievements made by Institute 44 in taking the route of military-civilian integration, resolute reliance on their own efforts, and arduous struggle in third-line regions. She also encouraged all the S&T personnel to continue their bold assaults on the peaks of S&T and to make even more high-quality S&T achievements in longwave infrared, night vision, CCD imaging, high-strength fiber optic transmission technology, and other areas to serve accelerated modernization and construction of our national economy and national defense. She said that the National Defense Science, Technology, and Industry Commission will slant its investment strengths toward

microelectronics technology, optoelectronic technology, and other key projects.

Natural Sciences Foundation Recommends Development Strategy for Atomic, Molecular Physics

91FE0680 Beijing WULI [PHYSICS] in Chinese
Vol 20, No 4, Apr 91 pp 193-197

[Article by the Natural Sciences Foundation Atomic and Molecular Physics Disciplinary Development Research Group, National Natural Sciences Foundation, Beijing 100031: "Proposals for Vanguard Fields and Near-Term Development in Atomic and Molecular Physics"]

[Text]

Abstract: This article briefly describes certain lively vanguard fields in atomic and molecular physics in recent years: atomic and molecular high excitation state structures, atomic and molecular collisions and their reaction dynamics, interaction of atoms and molecules with radiation, atomic and molecular clusters, and so on, and it offers suggestions on the development of atomic and molecular physics in China in the near term.

Atomic and molecular physics is a science that studies atomic and molecular structures, laws of motion, interaction, and effects on them from the surrounding environment. It includes atomic and molecular structures, the interaction of atoms and molecules with radiation, atomic and molecular collisions, potential energy functions, and so on. Atoms and molecules are the first microlevel of material structure and are the gateways to the microlevels above and below, atomic nuclei and particles. Atomic and molecular processes exist widely in all types of micro, macro, and cosmic processes ranging from condensed state and plasma properties to various complex chemical and life processes, as well as the evolution of all types of celestial bodies and nebulae. All of these things are closely linked to atomic and molecular processes and their properties. Atomic and molecular physics provides basic theories, experimental methods, and basic data for related disciplines and plays important roles in the energy resource, materials, environmental, and national defense industries. Countless examples show that atomic and molecular physics plays an important role in promoting the development of science and technology and in social progress. Everyone knows that the indicator of modern physics is the establishment of quantum theory and that the experimental foundation of quantum theory is research on atomic spectra and various types of collisions. A total of 83 Nobel Prizes in physics were awarded between 1901 and 1989, and 19 of them went to scientists who had made contributions in the fields of atomic and molecular physics.

This article will briefly introduce certain vanguard areas in atomic and molecular physics and offer some proposals concerning the development of atomic and molecular physics in China in the near term.

I. Certain Vanguard Realms in Atomic and Molecular Physics

A. Research on atomic and molecular structures

Atomic and molecular structures are a basic question in atomic and molecular physics research. The establishment of atomic and molecular physics research during the 1920's was a primary indicator of its peak period and it underwent a resurgence during the 1960's. Research on atomic and molecular structures in the past and up until today continues to be a main aspect of atomic and molecular physics research, but the content and focus of the research are different. The focus of modern research on atomic and molecular structures is on high excitation state structures of atoms and molecules and on other new systems.

Research on atomic excitation state structures has always been a main aspect of research in atomic physics. Since the mid-1970's, due to requirements in the space, laser, controlled nuclear fusion, isotope separation, and other high-tech fields, and because of advances in laser spectra technology, collision and electron energy spectra technology, measurement technology, and computing methods and technology, research on atomic excitation state structures has been done in a wide-ranging manner. The focus of research on atomic excitation state structures at present has shifted from low excitation states to high excitation states, from outer shell electron excitation to inner shell electron excitation, from neutral atoms to ionized state atoms, and from simple atoms to complex atoms.

High excitation state atomic structures usually are composed of countless Rydberg states, countless auto-ionization states, and the corresponding continuous states. An atomic high Rydberg state is a weakly-bound system and has a relatively simple structure. It is strongly interactive with radiation, has a large collision cross-section, and is sensitive to outer field anomalies. Research on Rydberg atoms created the research field of atomic high excitation states and provided large amounts of data on atomic structures. Research on atomic Rydberg structures is still very lively at present and is making new advances toward even higher excitation states (n approx. 300), high angular momentum states (including circular states), heavy atom (especially rare earth elements) Rydberg states, and other areas.

Atomic auto-ionization states are a new atomic state and have research significance. Moreover, they have been attracting attention because they are closely interrelated with research on celestial bodies, controlled nuclear fusion, and other areas, because new types of vacuum ultraviolet excited radiation may be achieved, and because they provide effective routes to laser separation of isotopes. In recent years, the achievement of high excitation dual-Rydberg states—planetary atoms—has attracted attention. They provide an effective method

for controlling and studying electron interaction phenomena and play an important role in studying questions of the dynamics of three-body quantum systems. Research on dual excitation states has led to the importation of the corresponding quantum numbers for atomic excitation states to make new classifications and describe new spectral laws.

Negative ions represent another weakly-bound system. Over the past several years, electron beam technology and high resolution spectral technology have been used to conduct more research on negative ion total energy, excitation state lifespan, metastable states, dissociation reactions, electron affinity, and so on, and it has become one of the liveliest fields in atomic structure research.

High ionization state ions appear in high-temperature plasma systems. The data associated with high ionization states include energy levels, excitation (or ionization) by collision with photons (or electrons), dual-electron recombination cross-sections, and so on, and these are indispensable data for research on X lasers, laser fusion, and magnetically confined fusion. There is still a blank at present on data in this field, with reliance mainly on theoretical computations, so there is an urgent need for experimental data.

Charged particle accelerators, beam screen spectra, powerful laser high-temperature plasmas, and so on have been used to obtain large amounts of information and data on high ionization state structures, lifespans, radiation and decay processes, and on inner shell and outer shell vacant site dual-trap potential and dual-electron recombination, and so on. Besides accelerators, the current feeling is that the most ideal equipment is electron beam ion traps (EBIT) which can strip up to 70 ions and have an ion confinement beam time of several hours. An even higher goal is to strip away the 92 electrons of uranium atoms completely and obtain a bare nucleus.

Research on molecular excitation state structures is a field that has been extremely lively internationally over the past several years. The basic difference between molecules and atoms is that molecules are a multi-nuclei quantum dynamics system that, based on Born-Oppenheimer approximations, can be considered to have electrons that move about in a potential field formed by a framework of nuclei. Thus, the first question in molecular structure research is determining the geometric structure of the nuclei, and the excitation state structure is different from the base structure. There are two basic theories for dealing with the question of molecular structures. They are valence bond theory and molecular orbit theory. The former provides a better interpretation of the geometric structure and chemical reaction properties of molecules, while the latter can be used for quantitative computations of a molecule's spectrum, excitation state energy level structure, and so on. Experiments usually employ visible and ultraviolet spectral region molecular spectra to study the energy level structure of a molecule's electron excitation states, but

identification of the spectral lines of the molecules is rather difficult. For the past several years, with the application of high-resolution laser spectra, ultrasonic jet flow, matrix isolation, and other technologies, abundant data have been accumulated on the spectra of small molecules containing a few to several 10 atoms and some molecular spectral lines have been identified. Understanding of large molecule excitation states is still in a blank state.

In addition, long-range molecules, open-core molecules, negative molecular ions, and other research involves vanguard topics.

B. Research on atomic and molecular collisions and their reaction dynamics

Collisions of atoms and molecules with other particles (photons, positrons, negatrons, and ions) occupies an extremely important status in atomic and molecular physics research. Statistics show that articles published internationally on atomic and molecular collisions account for three-fifths of the total number of articles in atomic and molecular physics. The reason they have attracted such wide attention is that these collision processes are closely related with atomic structure, molecular structure, and other states, and are also common in celestial bodies, interplanetary space, the Earth's atmosphere, plasmas, and chemical reaction processes. Thus, extensive research on atomic and molecular collision processes provides rich and profound understanding of the fundamental laws of atomic and molecular physics and greatly promotes the development of celestial physics, atmospheric physics, plasma physics, chemical reaction dynamics, and even solid physics and materials science.

It is precisely for this reason that since the 1960's research on atomic and molecular collisions has entered an entirely new era. Internationally, the personnel involved in research in this field and the number of articles published in have increased 20-fold and 10-fold, respectively. Three representative series of international conferences which are indicative of the research achievements in this field are the International Conference on Electron and Atomic Collisions (ICPEAC), International Conference on Atomic Physics (ICAP), and International Conference on Atomic Collisions in Solids (ICACS). They have continued without interruption and on an ever-widening scale.

Atomic and molecular collisions are divided into categories according to the particles involved in the collisions: collisions of photons with atoms and molecules, collisions of electrons (positrons) with atoms and molecules, collisions between ions, and collisions between ions and the atoms in solids. In this collision research, the earliest to develop was collisions of electrons with atoms and molecules. The widest ranging research has been done on ion-atom and atom-molecule collisions and accounts for the largest number at present, but it has

shown a tendency toward declining in recent years. Collisions of atoms in solids is a topic that has aroused extremely great attention.

Research on collisions of electrons with atoms and molecules has a history of more than 60 years to date. Many people are now interested in collisions between electrons and molecules because collisions of electrons and molecules concern multi-electron and multi-center questions. Besides causing electron excitation, the collisions very easily induce vibration excitation and rotational excitation because of the very small intervals in the vibration and rotation energy levels of molecules.

For the past 20 years, research on collisions between ions and atoms and collisions between atoms and atoms has developed in a wide-ranging fashion. Accelerators have been used to produce atomic and molecular (ion) beams for conducting atomic and molecular collision experiments and a momentum of flourishing development has appeared. This is especially true for using these beams to "prepare" special state particles, such as the ability to make complete determinations of the quantum states of atoms and molecules before and after colliding and to do artificial control and selection to conduct "complete" collision experiments. At present, such experiments are capable of determining some quantum states. As advances are made in experimental technology, "complete" collision experiments will become a possibility.

Research on the dynamics of collision processes is another hot topic in today's atomic and molecular physics. Atomic beams, molecular beams, and laser beams are used in alternation to conduct experiments to study excited state ion and molecular reaction collision processes and to be able to obtain precise information on the dynamics of collision processes. This research will reveal the essence of molecular reaction dynamics.

Collisions of particles with atoms in the environment, especially atoms in solids, is a topic that has attracted attention in recent years. The content of this research concerns various aspects of the interactions of particles with atoms in solids: channels and channel radiation, energy loss, charge exchange, atomic secondary electron and photon emission, ion beam mixing, atom and ion break-up and transmission, ion interaction with surfaces and boundaries, ion-induced sputtering and radiation losses, desorption, and so on.

C. Research on the interaction of atoms and molecules with radiation

The interaction of atoms and molecules with radiation has been one of the most lively branches of atomic and molecular physics in recent years. This is particularly true for the utilization of the high power and monochromatic properties of lasers, which can be used to make highly accurate determinations of various data concerning atoms and molecules, study the properties of atoms and molecules under special conditions, control the movement of atoms and molecules, and so on.

Photo-ionization can be carried out directly, or it can be carried out via an auto-ionization state. The ionization threshold of atoms and molecules ranges from several to more than 10 eV, which is equivalent to the energy of a photon in the vacuum ultraviolet region (wavelengths shorter than 200 nm), so all types of radiation with longer wavelengths (the shortwave portion of sunlight, X and γ rays, synchronous radiation, and plasma radiation, for example) can cause ionization of atoms and molecules. This is a single photon ionization process. When the light intensity is extremely strong, under conditions of strong laser pulses, atoms and molecules can simultaneously absorb multiple photons whose total energy exceeds their threshold value, which can also cause them to be ionized. This is called multi-photon ionization (MPI). The multi-photon ionization process includes intermediate resonance energy levels and its ionization cross-section can be increased by several energy levels, causing resonance-enhanced multi-photon ionization (REMPI). Because the selection rules that the multi-photon process follows are different from the single photon process, the former can attain a state that is forbidden to single photon ionization. Another advantage of the multi-photon process is that the polarization effects of light can be used for direct differentiation of molecular state symmetry associated with the transition. REMPI is widely used in the fields of physics and chemistry. It can be used to study molecular excitation states, ion and free base reaction dynamics, and energy transfers between molecules and the energy within molecules. Laser separation of isotopes is a prospective way to solve the energy problem.

Light fragmentation is another important question in the interaction of atoms and molecules with radiation. There are two types of light fragmentation. Molecules can attain an electron release state after absorbing visible or ultraviolet light and be directly dissociated, or they may become dissociated by passing through a pre-fragmentation state. This is typical photochemical fragmentation. Another way is to use infrared multi-photon absorption, overtone absorption, stimulated emission pumping, and so on to cause the molecules to attain a high vibration excitation state and the internal energy in the molecules is transferred to a chain and causes it to fracture. There are important applications for research on molecular photolysis, such as using it to solve the problem of destruction of the ozone layer in the Earth's upper atmosphere, using water photolysis to make hydrogen to store solar energy, using photolysis to make high power chemical lasers, and so on.

The effects of lasers on atoms and molecules on the one hand can cause changes in atomic and molecular internal energy levels and states, and on the other hand can cause changes in their overall velocity, momentum, and kinetic energy and thereby cause heating, cooling, deflection, collimation, focusing, and other effects. In research on these effects, research on laser cooling has developed quickest and the cooling temperature has now been reduced to 5 μ K. The cooling and confinement of atoms

(or ions) can be used for pathbreaking research on the basic characteristics and processes of single atoms, for research on systems (antiparticles, antimatter, high ionization state atoms, etc.) that are hard to maintain under other conditions, for measuring metastable state lifespans, and so on.

D. Research on atomic and molecular clusters

Atomic clusters are compounds of a small number (a few to a few hundred) atoms or molecules. They are widely found in chemical and physical processes. Atomic clusters have properties between single atoms, molecules, and condensed state matter and they have a physical structure shape between a gaseous state and solid state. Some people call them the "fifth state of matter". Research on the formation, structure, and properties of atomic clusters may be used as a bridge between atomic and molecular physics and condensed state physics.

Research on atomic clusters began internationally in the 1960's and a few research results were announced during the 1970's. Larger scale experimental and theoretical research appeared in the 1980's, but clusters are a problem that has still not been solved.

Because atomic clusters have unique properties that are different from single atoms, molecules, and condensed states, present-day theoretical and experimental research in general is proceeding in two directions: 1) In the atom-to-solid direction, studying increases in the number of atoms (molecules) in an atomic cluster to what extent that causes an abrupt change in the single characteristics of the atom (molecule). 2) In the solid (ultrafine particle) to atom direction, studying reductions in the size of ultrafine particles to what extent that causes an abrupt change in the overall properties of the solid. It can be expected that as research on these questions continues to intensify, it will be possible to design and develop new materials with unique properties at the atomic and molecular levels.

Research on atomic clusters has progressed very quickly. Much spectroscopic information has been obtained from a great deal of research work on atomic and molecular dimers. Dual-photon ionization technology has also been used for research on trimer electron absorption spectra. Research on heavier atomic clusters has mainly been restricted to work in the area of photo-ionization potential. In the area of research on atomic clusters in the solid-to-atom direction, the main work has all been focused on exploring laws of changes in the physical properties and chemical properties of solids with the size of atomic clusters.

Research on atomic and molecular clusters awaits further intensification. At present, there is been very inadequate research on the structure of gaseous atomic clusters with $n > 3$. There is still very little understanding of metallic atomic clusters and certain results of experimental research are very scattered and there are large discrepancies in the data. Most theoretical models

have stopped at the phenomenological description stage and the scope of applications is very narrow.

II. Proposals for Short-Term Development of Atomic and Molecular Physics Research in China

A. The current situation

China's atomic and molecular physics research has a relatively long history and the previous generation of atomic and molecular physicists made major contributions. There have also been significant developments in this field in the past decade. According to a 1988 survey, there are over 50 units in China involved in this line of research with over 200 personnel with high-level job titles and over 100 research topics. From 1986 to 1989, among the 37 projects funded by the National Natural Sciences Foundation, there were two major projects which received total funds of 3.178 million yuan. According to reports from 1986 to 1989 in ZHONGGUO WULI WENZHAI [CHINA PHYSICS ABSTRACTS], there were a total of 581 theses on atomic and molecular physics research, accounting for 3.1 percent of the total number of theses in physics. The main research equipment is laser spectra experiment facilities along with small accelerators, ion traps, intersecting beam facilities, and so on that can be used for atomic and molecular physics research. In addition, the completion of synchronous radiation and heavy ion accelerators will provide effective new means for atomic and molecular physics research.

In terms of research content, atomic and molecular structures and theories on electron scattering with atoms and molecules have the longest history. Atomic frequency marker research has contributed to national economic and national defense construction. At present, more research is being done on atomic and molecular excitation states and research on multichannel quantum loss theory has received national defense awards. Research has also been done on high ionization states, inner shell electron excitation states, laser spectra, the behavior of atoms and molecules in powerful magnetic fields or powerful laser fields, collisions of ions with atoms and molecules, collisions of ions with the atoms in solids, atomic clusters, interstellar atomic and molecular questions, and so on and many achievements have been made. Work to establish atomic and molecular databases has already begun. In 1982, the Atomic and Molecular Physics Special Commission (under leadership by the China Physics Society) was formally established to better promote further development of work in this area.

B. Directions and goals

Based on development trends in atomic and molecular physics and in conjunction with actual conditions in China, basic research in atomic and molecular physics in China should select limited goals and strive to do outstanding and creative research in atomic and molecular high excitation states and high ionization states, collision dynamics, atomic clusters, collisions of atoms in solids,

and other international vanguard fields. At the same time, the high-tech requirements of China's national economic and national defense construction should be used as a basis for selective atomic and molecular theoretical and experimental research on X lasers, nuclear fusion, high-speed aircraft, and so on that are urgently needed in China to provide data and methods and make contributions to the development of high technology in China and also attain the corresponding development in atomic and molecular physics itself. For the development of high technology in China, it is extremely necessary that we take solid steps to establish an atomic and molecular database in China in the short term. This work can be used to lay a firm foundation for further development of future atomic and molecular physics research in China.

C. Vanguard topics

After repeated study at the National Atomic and Molecular Physics Conference, everyone felt that these should be the vanguard topics at the present time:

1. Research on atomic and molecular high excitation states, high ionization states, and other new systems;
2. Research on the special environmental reactions of atoms and molecules;
3. Research on photo-ionization, photo-dissociation, and inner shell excitation and ionization;
4. Research on atomic clusters;
5. Research on collision processes of atoms and molecules with other particles and on the dynamics of de-excitation processes and state-state reactions;
6. Research on collisions of atoms and molecules in solids;
7. Research on laser manipulation of atoms and molecules and new precision spectral methods;
8. Research on new ideas, new methods, new technologies, and new equipment related to basic atomic physics.

D. Measures and proposals

When formulating and implementing other disciplinary plans or high-tech plans that are closely related to atomic and molecular physics, we should accept participation by atomic and molecular physicists.

We should increase investments in the field of atomic and molecular physics. Besides the need to maintain stable and appropriate increases in allocations from basic scientific research funds, even more important is for the relevant administrative departments to make a substantial increase in their investments in basic research as part of state high technology plans and national defense scientific research expenditures. Atomic and molecular physicists should orient toward high-tech plans and plans to attack key problems in energy resources, materials, the environment, and other

areas and undertake basic research in atomic and molecular physics as a part of applied science to use their own superior "services" to obtain more funds.

We must improve the deployment of atomic and molecular physics research. Adhere to the principle of limited goals, appropriate scales, and crack personnel, select certain units with better conditions for focused support, adopt the methods of opening up, circulation, integration, and competition, and gradually form a Chinese or even an international atomic and molecular physics research center. Laboratories which formerly had less than rational deployments should pay attention to fostering the advantages of the units where they are located, gradually form their own research specializations, and strive to avoid low-level repetition. Conscientious organization of assessments are needed for new deployments.

We should select good breakthrough points. This means that we must give consideration to the development needs of the discipline itself and track world scientific development trends, and we must adapt to China's economic development needs, conform to China's present economic strengths, personnel distribution, and other real conditions, solve major scientific and technical problems that urgently need solving at the present time, and organize theoretical, experimental, engineering technology, and other personnel for a cooperative battle. With a prerequisite of coordinated development of theory, experiments, and developing applications, we should pay particular attention now to construction of atomic and molecular physics experimental foundations and develop basic technology related to atomic and molecular physics like laser beams, atomic beams, molecular beams, ion beams, ultra-high vacuums, spectrometers, multi-channel analyzers, and so on.

We should be concerned with rational structures in research staffs. We must maintain rational proportions of advanced, mid, and low levels, theoretical and experimental technology, and other categories of personnel. This requires selecting and training academic leaders with good foundations and lively scholarly ideas, and we should give special attention to establishing powerful technical staffs. At present, there should be special concern for allowing superior quality young people to enter the research field to create a group of superior quality S&T experts in the next generation.

We should actively develop international cooperation and exchange. It is relatively easy for basic research in atomic and molecular physics to establish cooperative relationships with foreign countries, and atomic and molecular physics research often has clear applications prospects, so we can use cooperation to determine several development trends associated with the high-tech realm in foreign countries. International cooperation and exchanges should be developed around key projects and key laboratories.

Finally, I suggest that we take firm steps to establish atomic and molecular databases in China. This is

extremely important for the development of high technology and national defense S&T in China.

Introduction to Key State Crystal Materials Laboratory

91FE0739 Beijing HUAXUE TONGBAO
[CHEMISTRY] in Chinese No 5, 18 May 91 pp 53-55

[Article by Wang Jiyang [3769 4949 2254] and Gao Zhangshou [7559 2874 1108]: "The Crystal Materials Laboratory"]

[Text] The Shandong University Crystal Materials Laboratory was one of the first key state laboratories established in China. It is supported by the Shandong University Crystal Materials Institute and is located in the eastern part of Jinan. Professor Jiang Minhua [5592 3046 5478], vice president of Shandong University and director of the Crystal Materials Institute, is also the director of the Crystal Materials Laboratory and its Academic Committee.

Research on functional materials is at the leading edge of materials science development and crystal materials are an important part of functional materials. They are an important medium for the inter-conversion of sound, light, heat, electricity, and magnetism. The formation and development of microelectronics, lasers, infrared, integrated optics, optical communications, and other new technologies are closely related to developments in crystal materials. Research on crystal growth and properties is a field that intersects with many disciplines. It is closely interrelated with physics, chemistry, geology, mineralogy, electronics, computer science, and even biology and medicine. Crystal materials are an important research target and development foundation for solid-state physics and solid-state chemistry. In today's information age, crystal materials have become a major material foundation and technological vanguard for the new world technological revolution and are playing an ever-growing role in S&T, economic, national defense, and other departments.

I. Development Outline

Shandong University began doing research on crystal materials in the late 1950's and has developed several 10 types of crystals over the past 30 years. It is one of China's main base areas in research on non-linear optical crystals, laser crystals, and thermo-electric crystals as well as piezoelectric, ferroelectric, and other crystals. Over 10 scientific research achievements have passed examination in recent years and most received state or province-level awards. For example, LAP crystals received a first-place state invention award, NYAB crystals were chosen as one of the top 10 news stories of 1986 by KEJI RIBAO [Science and Technology Daily] and the Central People's Television Station and received a first-place State Education Commission award, TGSAs crystals received a third-place state invention award, KTP crystals received a second-place state S&T progress

award, and so on. Several crystals like KTP, NYAB, and others have produced very high economic benefits and been exported to the United States, Japan, and other countries in recent years and earned \$1 million in foreign exchange.

Research on crystal materials is also closely integrated with personnel training. From the 1950's to today, several 100 undergraduate and graduate students have graduated and have been distributed to all areas of China to become a professional backbone force in many units. At present, the Crystal Materials Institute is the key point in the discipline of solid-state physics in China as well as a training point for doctoral and masters' students. Research on crystal materials at Shandong University has attracted the attention of the university and relevant higher-level departments, so it has developed rather quickly. In 1963, after receiving approval from the Ministry of Higher Education for the establishment of a Crystal Growth Research Office independent of the department, it had 30-odd full-time scientific research personnel. It was expanded to become the Crystal Materials Institute in 1978 and the number of full-time personnel was increased to more than 70. In 1984 the State Planning Commission and Ministry of Education approved construction of the Key State Crystal Materials Laboratory supported by the Crystal Materials Institute and the number of full-time personnel increased to almost 100 people.

The Shandong University Crystal Materials Laboratory was completed in 1987. It was opened to other units in China in the same year. It is now funding 30- plus projects and several 10 visiting personnel and graduate students have come to the laboratory to work. The laboratory provides them with excellent research conditions and living conditions.

II. Primary Research Directions and Research Contents

Determination of research directions first of all requires consideration of the developmental laws of the discipline of crystal materials. It requires comprehensive research on organization, structure, and properties and must be closely integrated with research on crystal growth, testing, and components. This is essential for providing clear objectives, powerful motive force, rapid development, and abundant achievements in the research work. When determining research directions, consideration also must be given to the new trend in photoelectronic materials toward the development direction of low dimensions, composites, and integration, and we must closely track the leading edge of the discipline and open up new research directions and realms.

After determination by the Academic Committee, the primary research directions and research content of the Crystal Materials Laboratory are:

A. Research on basic processes of crystal growth

The basic processes of crystal growth include boundary processes, transport processes, crystal growth dynamics,

and so on. Research in this area enables development of crystal theory and is closely related to improving crystal growth rates and quality. The main research content in the near term is:

1. Applying holography to study crystal growth boundary processes.
2. Liquid flow effects and impurity effects.
3. Solution growth and auxiliary solvent growth dynamics.
4. Solution (including high-temperature solution) states and stability.
5. Polymorphic changes and metastable phase growth theory.
6. Basic research on crystal growth under hydrothermal conditions.
7. Crystal growth characteristics and the relationships of surface topography, defects, and growth conditions.
8. Crystal growth Monte-Carlo computer simulation.
9. Phase diagrams.

B. Exploration and research on new functional crystal materials

This direction is a focal point of research work in this laboratory in the short term. The research content is exploration of new functional crystal materials and modification of existing functional crystals, including:

1. Self-activating and self-frequency multiplying compound function crystals, longwave, long and new waveband, and tunable laser crystals.
2. High figure of merit, broadband new non-linear optical crystals (including inorganic, organic, and metallic-organic complex crystals).
3. Light refraction and optical bistable crystals.
4. Piezoelectric, ferroelectric, thermoelectric, and other functional crystals.
5. Determination of the structure of new crystals (especially low symmetry crystals).

C. Research on the physical properties of crystals

The objective here is comprehensive determination of the properties of crystals, discovering new functions of crystals, and opening up new applications. This involves exploration of the foundation of new functional crystals and is indispensable for crystal applications. The research content includes:

1. Research on crystal interaction effects, multifunction compound effects, and overall optimization of their properties.

2. Research on the nature of crystal functions and on the relationships among crystal composition, structure, defects, and so on.

3. Exploration and research on new functional effects and new physical phenomena of crystals.

4. The physics of crystal functional components and development of new components.

D. Research on the development and properties of thin film crystal materials

On the basis of developing metallic-organic compound electrochemical raw materials (MO), this mainly involves using metallic-organic compound chemical vapor deposition (MOCVD) epitaxy technology to conduct research on semiconductor and oxide thin film growth. The scope of near-term research is:

1. Synthesis and purification of metallic-organic compounds (including adducts).
2. Research on oxide thin film crystal material epitaxial (LPE and MOCVD) growth.
3. MOCVD method growth of group III-V compound thin films.
4. Research on the photoelectric, waveguide, electrical, and other properties of thin films.

III. Primary Instruments and Equipment

The laboratory basically has a full set of instruments and equipment for inspecting crystal growth and quality and for testing physical properties. The main ones are:

1. VP-50 metallic-organic compound vapor phase deposition device, produced in Switzerland. It is suitable for use in research on group III-V and II-VI binary, ternary, or quaternary semiconductor thin film crystals.
2. Multifunction monocrystal oven, produced by England's Crystalox Company. It has lifting and drawing and region devices as well as a cooled crucible and cooled vessel that can be used to grow various types of oxide-magnetic metallic and other hard to melt monocrystals.
3. MR1B-4 hydrothermal growth system, produced in the United States. The maximum temperature is 850°C at 3,000 atm, and it can be used to determine the basic parameters and curves of crystal growth under hydrothermal conditions and for research on hydrothermal growing of crystals.
4. R3m/E X-ray four-sphere diffractometer, produced by the Nicolet Company in the United States. It is used to determine the structure of monocrystals.
5. CN-1514A fine focusing X-ray generator and topographic camera, produced by Nihon Rigaku Co. It is used for studying crystal integrity.

6. Thermal analysis system, produced by the P-E Company in the United States. It includes a DSC-ZC differential scanning calorimeter, DTA 1700 differential temperature analyzer and TGS-2 thermogravimetric analyzer and thermomechanical analyzer that are used for research on matter phase changes, phase diagrams, specific heat, and so on.

7. PN-2400 semiconductor measurement system, produced in England. Used to measure the volt-ampere characteristics, carrier concentration, and so on of semiconductor or thin film materials.

8. Pulsed acousto-optic elasticity measurement system, produced in the United States. Used to study the elastic properties of crystals, phase changes of soft models, and so on.

9. E4280 elliptical polarizer, produced in the United States. Used to measure membrane thickness and refractivity.

10. Crystal non-linear property measurement system capable of measuring all non-linear coefficients of crystals.

11. Integrated measurement system for electrical parameters of crystals, produced by H-P in the United States. Capable of highly precise measurement of various electrical parameters of crystals.

12. 9836 minicomputer system produced by H-P in the United States. Multiuser system interface, can be connected with various instruments for physical testing of crystals.

13. Laser holography device with additional camera and image recording devices, suitable for use in observing crystal growth processes and studying growth dynamics.

14. Integrated photoelectric-piezoelectric measurement system. Uses an interference compensation method for one-time measurement of electro-optical coefficients and piezoelectric coefficients.

The laboratory also has a precision optical dual-refraction tester, multifunction interferometer, miniature weak optical signal measurement system, ultraviolet-visible-near infrared photometer, various large microscopes, and other instruments and microcomputer-controlled crystal ovens, and other growing equipment. In addition, the experiment center at Shandong University also has a 20SX Fourier transform spectrograph, Spex 1403 laser Raman spectrograph, 4510 integrated color and mass spectrograph, S520 scanning electron microscope, JEM-100CXII transmission electron microscope, FX90Q pulse Fourier transform nuclear magnetic resonance spectrograph, and various other large precision instruments that can be opened in conjunction with the laboratory for coordinated use.

IV. Management System and Work Methods

The Crystal Materials Laboratory is supported by the Crystal Materials Institute and is a relatively independent scientific research entity which implements an open common-use management system.

The laboratory has an Academic Committee that is the scholarly assessment organ of the laboratory. It is composed of colleagues experts from related disciplines in China and no fewer than two-thirds of the experts are from outside units. The current session of the Academic Committee is composed of 13 members with Jiang Minhua as director and Min Naiben [7036 0035 2609] (Nanjing University) and Peng Ruiwu [1756 3843 0124] (Chinese Academy of Sciences Shanghai Metallurgical Institute) as deputy directors. There is also an academic secretary.

To ensure that the laboratory is fully opened up, some of the experimental and technical personnel have fixed assignments for the large instruments. Taking into consideration the need to organize projects and increase instrument utilization rates, some research personnel with high-level positions in the Crystal Materials Institute were hired as leaders for positions involving several research directions and certain instruments. There are a total of nearly 30 such personnel.

Funding for the laboratory is provided by higher-level departments. The funds include operating costs, topical research costs, project funds applied for through various channels by scientific research personnel, and subsidies allocated out of development funds by the supporting units.

The laboratory has published an open fund application guide. After being evaluated by experts and being passed by the Academic Committee, project applications receive monetary support from the open fund. Besides being used for the materials costs, instrument and equipment use costs, and testing costs required by the research work, the monetary assistance also includes travel differential costs, housing costs, and various subsidies.

Fees are collected according to stipulations for the use of laboratory instruments and equipment that have not been included in laboratory topics. The fees are used for raw material replenishment, water and electricity consumption, and instrument maintenance. Special allowances in fee collection are made for graduate students and young S&T personnel with limited funds. To encourage people to bring projects to the laboratory and work, the laboratory only receives 5 to 10 percent of project funds and the instruments and equipment are still open for use. These stipulations also cover the supporting units.

The laboratory makes preferential arrangements for visiting personnel to use its instruments and equipment and makes the greatest effort to provide experiment conditions. We warmly welcome colleagues, experts, and S&T

personnel from all over China to submit project applications to our laboratory or bring their own projects to the laboratory to undertake independent or cooperative research work.

Boosting Weapons Development With High Technology

91FE0612A Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 9 Apr 91 p 2

[Article by reporters Wu Shuangjing [0702 7175 6975] and Wang Daitong [3769 0108 0681]: "National Defense Science, Technology, and Industry Commission Vice Chairman Shen Rongjun [3088 2837 7486] Says Use High Technology To Spur Weapons Development"]

[Text] National People's Congress delegate and National Defense Science, Technology, and Industry Commission vice chairman Shen Rongjun said in a meeting with reporters on 5 Apr 91 that China's weapons development should focus on promotion by high technology and establish a large systems concept. In China's national defense scientific research, we should make breakthroughs in electronics technology, applied satellite technology, and other key areas, where there is much that can be done.

Shen Rongjun said: "there must be a correct relationship between the national economy and national defense construction. The national economy is the foundation, but without national defense, prosperity for our people is not the same as being a strong country, so consideration must be given to both these areas. The relationship between the two is not one of opposition but is instead mutually complementary, particularly in the area of national defense S&T.

"Using high technology to spur weapons development can allow us to take somewhat larger steps in modernization of China's national defense and can promote development of the national economy as well. Practice inside China has confirmed that developing incisive national defense technology often spurs progress in other industries and plays a 'tap' role. The widespread application of nuclear technology in the 1960's in agriculture, industry, medicine, and other areas following the birth of China's 'two bombs' [atomic and hydrogen] is a very good example. The reference to large systems means that modern warfare is high-tech, all-azimuth three-dimensional warfare which requires attention not only to the threat of firearms themselves but also to a set of systems to guarantee that they foster their threat."

When reporters asked how to develop national defense S&T faster and better given China's limited expenditures on national defense, Shen Rongjun said: "given our economic strengths, an all-out charge is unrealistic, but we can focus on key areas and make breakthroughs in certain of them and then use these breakthroughs to spur others. At present, the most important of the key areas is electronic technology. Many of our weapons and equipment are not backward, but they do lag behind because

electronic technology cannot keep pace. China's carrier rockets, for example, are relatively advanced but our poor electronic technology has affected development of our satellite industry and created a situation of "one long leg and one short leg" in our space industry which has affected national economic and national defense construction as well as the market for commercial launches on Chinese carrier rockets for foreign countries. Satellites will be more widely used in national defense construction and national economic construction, so development of applied satellite technology is an urgent task, but this first of all requires development of electronic technology, especially microelectronic technology. The development and widespread application of electronic technology will play an enormous promoting role in all realms of our national economy."

Consultative Organization To Support Defense S&T Policymakers

91FE0819G Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 27 Jul 91 p 1

[Article by Xinhua Agency reporter Xu Zhimin [6079 1807 2404] and KEJI RIBAO reporter Wang Hanlin [3769 5060 2651]: "National Defense Science, Technology, and Industry Commission To Fully Foster the Collective Wisdom of Experts To Promote Science and Democracy in National Defense S&T Policymaking"]

[Text] The National Defense Science, Technology, and Industry Commission has invited several hundred experts and professors to participate in high-level policymaking consulting work on national defense S&T to gradually form a macro management system that integrates leaders and experts that will play an active role in the development of China's national defense S&T, weapons, and equipment. The National Defense Science, Technology, and Industry Commission recently held a grand meeting in Beijing to commend several experts and expert groups that have made important contributions to policymaking consulting.

National defense S&T work involves knowledge-intensive and wide-ranging systems engineering. The National Defense Science, Technology, and Industry Commission has long been concerned with fostering the collective wisdom of experts in all areas in its macro administration and with promoting science and democracy in major policymaking. Back in the early 1960's, under the leadership of Nie Rongzhen [5119 2837 5271] and other revolutionaries of the previous generation, the National Defense Science Commission at that time established several new technology expert groups with participation by Qian Xuesen [6929 1331 2773] and other famous scientists that played an important role in macro management of national defense S&T. In the past few years, the National Defense Science, Technology, and Industry Commission has invited over 200 experts and professors from relevant scientific research organs and institutions of higher education inside and outside of the military throughout China to form special groups

for microelectronics technology, precision guidance technology, optoelectronic technology, new military materials applications, military simulation technology, military computer technology, military battery technology, detonation technology, hydrodynamics, and so on, and they have absorbed over 50 key disciplinary leaders to become concurrent members of the Science and Technology Committee in the National Defense Science, Technology, and Industry Commission's to form a technical consulting and advisory organ for national defense S&T policymaking. These experts have participated in importing soft science topic research on national defense S&T and have provided a scientific foundation for China's high-level policymaking.

Most of these experts are from the first line of scientific research and experimentation and have rather high capabilities for attacking key technical problems and management levels. They have a powerful sense of mastery and responsibility and are actively engaged in comprehensive debate and assessment of major topics in China's preliminary research plan for national defense S&T. They have written over 1,000 special topic research reports of all types, compiled preliminary research project plan guides for major technical fields, participated in the selection of several key technologies for national defense S&T during the Eighth 5-Year Plan, completed topical demonstration work for major weapons and equipment systems, and done a great deal of work to train national defense S&T personnel, evaluate S&T achievements, and so on. The seven special groups and over 50 experts commended this time are their top-notch representatives.

At this commendation meeting, National Defense Science, Technology, and Industry Commission chairman Ding Henggao [0002 5899 7559] and leaders from relevant departments issued certificates of merit and honorary certificates to the expert groups and experts receiving the commendations. Ding Henggao stressed during his speech that the main task of the experts at the present time is to do research on how to seize the opportunity to readjust the scientific research structure in order to make a great span in development of national defense S&T. Leaders at all levels must further create the conditions, fully foster the technical consulting and advisory role of the experts, and continually raise scientific policymaking levels.

Pharmaceutical R&D Management Reform Discussed

91FE0819C Beijing ZHONGGUO KEJI LUNTAN
[FORUM ON SCIENCE AND TECHNOLOGY IN
CHINA] in Chinese No 4, 18 Jul 91 pp 36-38

[Article by Tao Zhonghua [7118 1813 5478]: "From Imitation to Innovation—Management of Pharmaceutical Scientific Research in a Period of Strategic Changes"]

[Text] The new development strategy for pharmaceutical research and production stipulated in the Eighth 5-Year Plan development program for China's pharmaceutical S&T is: gradually achieve a strategic shift from imitation as the main direction to the dominance of innovation. The focus of innovation for new medicines is to foster China's traditional pharmaceutical and natural resource advantages and develop unique superior quality medicines from plants, animals, microorganisms, and other products of nature. The objective is to replace imports, gain control of the domestic market, and gradually move into international markets. In making this strategic transition, pharmaceutical research must be at the forefront of production. The reason is that it usually takes over a decade to select, study, and approve production of a new drug, so we must focus on them starting now. Given the considerable weakness of China's foundation for creating new drugs, the extremely limited capital that can be invested, the many factors in the traditional system that are not favorable to innovation, and the possibility that new contradictions and difficulties may appear in system reform, special attention must be given to adopting measures in the administrative area to open up new routes for drugs. Little time remains in this century and we must certainly have a sense of urgency about this.

It should be said that we already have a definite foundation in research on the development of new drugs from the products of nature, especially Chinese herbal medicines. The Pharmacology Institute in the Chinese Academy of Medical Sciences is an important research base area. Since its founding in 1958, 44 of the 53 new drugs that this institute has developed and successfully used in clinical practice have been related to plants. Of these, 29 were directly extracted and prepared from plants, 10 were obtained by full synthesis from chemical copying on the basis of research on the components in Chinese herbal medicines, and four were new chemical compounds obtained by transforming structures during the full synthesis process. Another one type was a synthetic product from directional design on the basis of research on the relationships between the structure and effectiveness of the products of nature. It is apparent from this that China's advantages lie in developing plant medications, which are a rich fountainhead for research on developing new drugs. Because there are a variety of ways to create new drugs from natural products, we are now developing in the direction of fully synthetic structural transformation and doing directional designing based on integrating the various relationships between structure and effectiveness. We have already prepared definite conditions in this area. One is that we have a foundation of traditional pharmacology and abundant clinical experience. A second is that progress in separation measures, widespread application of modernized spectrographs, and substantial developments in methods of assessing physiological activity have greatly increased the speed at which new compounds with physiological activity are discovered. With the continual discovery of active components, the accumulation of large amounts of data in the area of the relationships between structure

and effectiveness, and advances in knowledge on human chemical reactions, drug acceptors, and other areas, new drug design is now facing a revolutionary transformation.

At the Pharmacology Institute, for example, we have extracted, separated, and selected nearly 200 types of physically active compounds from hundreds of plant and animal varieties in just the past 5 to 6 years and 10 percent of them have been or will be included in projects to serve as vanguard compounds for research and design of new drugs. The institute has now established nearly 100 selection models and methods and can do selective research on many types of diseases including tumors, cardiovascular diseases, hepatitis, nervous and mental disorders, anti-inflammatory, immune, digestive tract, diabetes, and so on. Over the past few years, besides supplementing and perfecting these methods, we have also established several new models and experimental systems in the external, molecular pharmacology, action targets, and other areas that have made selection tend to become faster, conservative, and accurate. We have also made progress in the areas of separation and structural determination that have enabled the extraction and structural determination of several components with extremely complex structures and extremely low contents. Biotechnology has been applied in rapid breeding, variety improvement, and biological conversion of effective components that have further fostered China's natural resource advantages. Among the drugs successfully developed by the Pharmacology Institute so far, some are compounds that have undergone structural transformation and have curative effects superior to the effective components extracted from natural products, so they have attracted considerable attention in international pharmaceutical circles. An example is biphenyl di-ester, a new drug obtained after chemical duplication and structural transformation on the basis of the drug (wuweizi) being studied. It has the effects of depressing and converting amino enzymes and protecting the liver in those suffering from hepatitis and is significantly superior to the effective components extracted from (wuweizi). Another example is isoindigo-A, a new drug developed through further research and directional design on the basis of the effectiveness of the ancient prescription of Chinese angelica aloe tablets in treating chronic granulocytic leukemia. Its anti-tumor and oral absorption results are both superior to indirubin, the active component in Chinese angelica aloe tablets and its gastrointestinal side-effects are much reduced.

The new drugs created in China that are now receiving the greatest attention in foreign countries are varieties with unique curative effects, including the new antimalarial drug green artemesin successfully developed by another unit, and others. To date, however, no independently created new Chinese drug has truly entered international markets. This to a certain extent is a reflection of new drug R&D levels in China as well as to our inability to satisfy the requirements of international market competition or new drug administration in foreign countries. Given that foreign countries are now

making major efforts to strengthen development of new drugs from natural active matter, if we fail to actively create the conditions to open up markets and do not make some international vanguard achievements in basic research on creating new drugs, we will still face the risk of being replaced when they reach the industrial production or market development stages.

Factors in many restrict the creation of new drugs. From the perspective of state macro management, the main problems that exist now are inadequate funds, detached systems, personnel shortages, poor cooperation and coordination, weak social support structures, and defects that arise from incomplete policies and laws and lack of coordination. I cannot resist giving several examples here:

In the area of funding, after China implemented a fund system, funds for most basic research must be applied for from the State Natural Sciences Foundation, but this foundation itself has limited funds and can only subsidize a few projects, and the strength of subsidies for each project are also low, so it is very hard to meet the requirements that the creation of modern new drugs places on basic research. In the area of applied research and development, the State Pharmaceutical Management Bureau does have new drug funds, but its funds are limited and it can only provide financial assistance for new drugs that can enter the development stage quickly. Given the selection work involved with large numbers of candidate drugs in the initial phase of research on new drugs, supplies of drugs for experimentation, long-term toxicity experiments, and so on, although a great deal of work is involved it does not receive funding support. Experience in foreign countries shows that creation of a candidate drug always requires selection from thousands of chemical compounds and that after clinical and long-term toxicity experiments, several have to be discarded. It takes an average of more than \$100 million in R&D expenditures until the time a new drug reaches the market. Thus, most development of new drugs in foreign countries is done by rather powerful large enterprises. Because of system restrictions, pharmaceutical plants in China are incapable of subsidizing the creation of new drugs. They prefer imitations or imports which produce faster results and are unwilling to work on innovative drugs that involve great difficulty, high risk, long schedules, and large amounts of capital. For several R&D units involved in developing key new drugs, however, they are affected by the existing allocation system and projects are becoming increasingly decentralized. A substantial part of the work required for drug innovation makes it difficult to apply for funding from the various existing capital channels and their situation is becoming more and more difficult. Thus, at the present stage, we still need to provide funds required for drug innovation from state financial allocations to be able to achieve the state's strategic objectives.

The comprehensive nature of the state's strategic objectives and the tendency toward the decentralization of departments and units is a major contradiction. I am not

even mentioning here the fact that every department has its own policies, are detached from one another, and lack organization coordination, which has led to a whole series of defects that have prevented the formation of a "fist" of momentum in drug innovation. Speaking simply from the perspective inside scientific research units, more and more people now prefer applying to do small projects that cover limited areas and can be completed by a small number of people in a short time. They are willing to play leading roles in small projects but unwilling to co-star in large projects. Moreover, after their research achievements have been examined and accepted, they are busy with new projects and are unwilling to expend much effort in the process of converting these achievements into forces of production. There are many factors behind these phenomena, but a major factor continues to be the low strength of project subsidies at present which forces people to start more projects in order to get more funding. Added to the strict limits in the S&T award system on the number of people rewarded and the ranking of articles and awards during job title evaluation, both of which affect promotions, they have even more misgivings about innovative work which involves long schedules and high risks and involves larger numbers of people. This shows that drug innovation requires both funding support and creating the conditions in the area of incentive mechanisms for work in all links involved in innovation.

Matching policies to promote innovative work are not limited to the internal part of the S&T system. There is also the question of the external environment. For example, the flood of imported goods at present has seriously affected initiative in China to develop new products. It would appear that we will have to use legal measures for comprehensive implementation of an imported drug licensing system before we can effectively control this situation. Moreover, China's present patent system has implemented no patent protections for new chemical entities, which is another major threat to those who develop new drugs, and I hope that this can be changed soon.

It is apparent that management of innovation involves systems engineering. Achieving a strategic shift from imitation to innovation first of all requires that the state make corresponding changes in the area of macro management and formulate funding sources, incentive mechanisms, and a series of matching policies to create the necessary conditions for new drug formulation. Given that the conditions do not exist at the present time for enterprises to play the primary role in developing new drugs, the state's key drug R&D units should be the vanguard and primary force in this strategic transition. This places strict challenges and even higher demands on scientific research management in these units. I am referring mainly to:

1. Changing the guiding ideology and undertaking work under the guidance of a new strategic principle. This strategic principle is concern for the conversion of S&T achievements into commodities as well as extremely

close attention to the quality, benefits, and competitiveness of new drugs in international markets. The goal is to take over the domestic market and open up international markets to form a benevolent cycle. This is like selecting members of the national team in sports by discovering young successors in our multitude of scientific research projects, continually selecting the best and providing focused support, and developing them in national "fist" products as quickly as possible. Although there are many traditional concepts like a focus on imitation and neglect of innovation, a focus on research and a neglect of development, a lack of an understanding of market competition, and so on that still have rather profound effects, as well as quite a few factors in policies and the environment that are unfavorable to innovation, the guiding ideology of managers cannot waver. Only in this way can these obstructions be removed and can we make the contribution we should be making to achieving the state's strategic objectives.

2. The ever-growing amount and scope of the information required during the innovation process is a serious challenge to innovators and to managers of the innovation process. All modern achievements in drug formulation are products which integrate achievements in many disciplines and the competition is extremely intense. This requires analysis of the advantages we can utilize and the difficulties we face from a large amount of information to enable us to adopt the necessary measures to make key breakthroughs. This includes advances in all related disciplines as well as information in the areas of finances, banking, foreign trade, law, production, and markets. Over the past few years we have frequently encountered project groups that have been puzzled by the lack of knowledge concerning award channels, new drug examination and approval, technology transfers, patents, intellectual property, and other areas. Sometimes this has even affected overall progress in innovation. Thus, administrators should strengthen their own study, continually expand information sources, and play a better role in information transmission, supervising and urging examination, and providing various types of consulting in their management work.

3. The tide of reform is now surging throughout China and the waves of contradictions and difficulties are occurring repeatedly. Innovation managers should walk at the forefront of reform. Not only must they adapt quickly to the situation of reform, but they also must be proficient at integrating the spirit of system reform with actual conditions in their units and opening new routes to drug innovation. For example, selective research under the new allocation system lacks funding sources. This, however, is the fountainhead for discovering new drug successors and atrophy in selection work will inevitably lead to inadequate reserve strengths for innovation. Besides the need to continually issue calls and applications to higher authorities, the method used in the Pharmacology Institute at present is to use its own earnings to pay some of its costs and to establish special

selection quantity awards and successor awards. Even doing things this way, however, there are many contradictions.

4. Drug innovations can only be completed through the joint efforts of many disciplines and all related units. The organizational coordination tasks that managers face in this area are extremely numerous. In clinical research, for example, a great deal of work must be done to choose cooperating units, formulate first phase clinical programs for new drugs, organize batch supplies of the drugs, and do repeated examination and confirmation of the clinical benefits and the results of animal experiments. Moreover, when the laboratory results are not the same as the clinical ones, whether the actual source of the problem lies in the raw material drugs, the preparations, or in the clinical area cannot be dealt with like imitation drugs where existing documents can be examined. They can only be resolved by the collective intelligence of everyone. In another example, during the operationalization stage for a new drug and cooperation with a production plant, whether or not the production technology for a new drug can satisfy the requirements of large scale production and whether or not it can produce the maximum economic benefits often requires the joint efforts of both parties before it can be solved. As for the long-term curative effects of a drug and monitoring and

assessment of its toxicity, there often must be a long period of detailed research and comprehensive analysis of data from many areas. This is precisely the key that affects whether or not China's innovative drugs can enter international markets. In summary, the responsibility of administrators is to be concerned with the possible occurrence of problems in any link during the innovation process and to organize the required forces as quickly as possible to solve them in conjunction with the relevant units.

At present, one of our main discrepancies in the area of drug innovation is the uneven development of related disciplines and the rather poor coordination and matching among them as a result. For this reason, to achieve the strategic transition from imitation to innovation, improving China's overall drug innovation capabilities should be a strategic task for this century. This means that, along with increasing financial and manpower inputs, we should also be concerned with comprehensive matching and our capacity for carrying out effective management of innovation. Improvement in our innovation management capabilities and fostering the initiative of managers will play an extremely important role in shortening drug innovation cycles and produce even greater social and economic benefits as quickly as possible with our limited inputs.

High-Tech Zones Update**Caohejing**

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[CHINA ELECTRONICS NEWS] in Chinese 17 Apr 91
p 1

[Article by reporter Mao Xifang [0379 6932 5364]]

[Text] The Shanghai Caohejing New Technologies Development Zone's high-tech R&D and production groups for microelectronics, and fiber-optics communications have been formed. In 1990 the Zone's industrial gross output value was 1.98 billion yuan, for a total profit of 170 million yuan, and export receipts of 63.82 million U.S. dollars. This is an increase over the previous year of 7.7 percent, 2.9 percent, and 44.5 percent, respectively.

The Shanghai Caohejing New Technologies Development Zone now has a total of 29 partially or wholly foreign-owned enterprises with total investments of 310 million U.S. dollars. It has altogether, 88 research institutes and enterprises of various types with a total of 42,600 technical and professional personnel. The Zone displayed its own high-tech products and scientific achievements at the National High-Tech Production and Development Zone exhibition held in Beijing in October of last year, and received high praise from Song Ping, Zou Jiahua, and other leaders of the Central Committee. The Zone has now been approved by the State Council and is listed among the National High-Tech Production and Development Zones. It will enjoy status under the national policy of further priorities for development of new technology industries.

In order to achieve new results in commercialization and production of bio-engineering, electronic information, automation, new materials, new energy resources, aeronautics and astronautics, instrument electronics, and laser technology, the Zone intends to bring electronic industries to the forefront, strengthen micro-electronics technology, development of computers and software, and also use electronics technology to transform conventional industries, and push new technological development.

Chengdu

91FE0653B Beijing ZHONGGUO DIANZI BAO
[CHINA ELECTRONICS NEWS] in Chinese
15 May 91 p 1

[Article by reporter Tang Jianwei [0781 1696 0251]]

[Excerpts] So far, 18 enterprises and 24 projects have requested admission to the Chengdu High-Tech Development Zone. It is estimated that the GVIO for the whole year will reach 120 million yuan, and will earn 24 million yuan in profit and taxes. In the Eighth 5-Year Plan the Zone will handle 100 high-tech projects, organize five industrial groups of modern communications,

integrated optics, machinery and electronics, and new materials, for an expected GVIO of 1.5 to 2 billion yuan, and profit and taxes of 460 to 500 million yuan. [passage omitted]

When construction of the high-tech development zone began it showed considerable vitality. The Chengdu Electric Cable Factory's fiber-optics communications cable development project, in only one-half year, refurbished its workshop, installed and debugged its equipment, and produced an optical cable that was up to standard. Electronics science research units and electronic enterprises, including the Southwest Institute of Communications and the Chengdu TV Equipment Factory also were quickly established. In 1989 a batch of decimetric wave differential converters and receivers were produced, as were other high-tech products, such as communications-privacy equipment and optical cables, the output value of which approached 30 million yuan, earning 7.1 million yuan in profit and taxes. In 1990 the output value increased to over 66 million yuan, with profit and taxes reaching 8.5 million yuan.

In February of this year the State Council formally approved the Chengdu High-Tech Development Zone as a national class high-tech Development zone. On 20 April, General Secretary Jiang Zemin, braving the heavy spring rains on his Sichuan inspection tour, came to the Chengdu High-Tech Development Zone to inspect the Southwest Telecommunications Research Institute and the Chengdu Cable Factory. After hearing the report on the construction circumstances of the development zone, he gave his approval for its construction. He said, Today the goals have been set, and the basic principles, and general and specific policies have been formulated, but the success of the Eighth 5-Year Plan and the 10-Year Program depends on the effort to develop science and technology. Only if there is resolve to rapidly develop S&T to raise the productive power of society, can the superiority of the socialist system be fully realized.

Changsha

91FE0653C Beijing ZHONGGUO DIANZI BAO
[CHINA ELECTRONICS NEWS] in Chinese
19 May 91 p 3

[Article by reporter Yang Yusong [2799 3768 2646]]

[Text] The Changsha S&T Development Experiment Zone established over two years ago is a brilliant success. Having begun in widely scattered locations, it is now in a new stage of centralized construction. The Standing Committee of the Hunan Province Committee, on hearing the report given by the Changsha Municipal Government, said, "The Changsha S&T Development Experiment Zone must be done unswervingly". This was the information announced on 20 April at a news conference jointly held by the propaganda department of the Changsha Municipal Committee and the office of Changsha S&T Development Zone.

The Changsha S&T Development Experiment Zone, established in October 1988, adopted a policy of "make do with what's available, start on the spot, unify control, and decentralize management". Considerable progress was made in getting investment savings, quick results, and an effective development model. By the end of 1990, 81 new technology enterprises had opened in the zone, 185 high-tech product projects got underway, and they produced a total output value of 171.61 million yuan, and earned 145.12 million yuan. Products were created by about 300 of the projects. The zone was recently approved by the State Council to be one of the 27 national high-tech industrial development zones.

Now the zone has entered a new stage of "Small zone program, centralized construction, scaled structure of management, and unified control". During the Eighth 5-Year Plan period its present scattered condition will be gradually centralized, the 200,000 square meter Changsha high-tech building will be constructed, the Maopo S&T Park will open up, the Yuelu Shan High-Tech Industrial Base and the Mapoling Agricultural High-Tech Test Base will be developed, five industrial groups, such as the super-microcomputer group, will be established, and 30 popular items, such as the Xieshi [6200 3044] computer compressed character base, will be developed. The zone will become a "special S&T zone", and as it will be the break-through point for high-tech industries, it will also be a break-through point for greater reforms and openness, to utilize the preferential policy to support special zones and special activities. Preferences will be given in all respects, to unite Hunan and Changsha into one entity, on the grounds, in the buildings, in capital construction, funding, import-export business, and laborer affairs. It is planned that by the end of the Eighth 5-Year Plan there will be 300 new technology enterprises, 650 new high-tech products, and an annual output value of 2 billion yuan, of which earnings in foreign exchange will be over 20 percent of the gross value of output, and 500 million in profit and taxes will be realized.

Wuhan Donghu

91FE0653D Beijing ZHONGGUO DIANZI BAO
[CHINA ELECTRONICS NEWS] in Chinese
19 May 91 p 3

[Article by reporter Wang Zixin [3769 1311 2946]]

[Text] The renowned, "Rising Sun Industries", the burgeoning enterprises springing up at the Wuhan Donghu High-Tech Development Zone that are relying on S&T development to raise a fountain head of new technology products have reached 102 in number. Unmindful of the rigors of soft markets the zone has sustained its momentum. Last year it had a total earnings of 281.793 million yuan, a 141.7 percent growth over the previous year.

The Wuhan Donghu High-Tech Development Zone this year had achieved more than 6,000 scientific research

projects. For several years the Wuhan Municipal Government has given the development zone various inducements to turn scientific achievements promptly into production strength. One small factory originally of Wuchang County, in 1987, took a medical YAG laser device, which was a research product of the Central China University of Science and Engineering, and in 1989 produced them for an output value of 900,000 yuan, and realized a profit of 200,000 yuan. In 1990 the output value was 1.36 million yuan, and profits doubled. The Central China University of Science and Engineering and a formerly insolvent enterprise, the Wuhan Barber Tools Factory, under joint management, produced PTC series electronic components and devices, and they have achieved an annual production capability of 3 million items.

The Development Zone continues to attract foreign capital. In the last 2 years the number of joint ventures rose to 16, and they have received a total of 20 million U.S. dollars in foreign capital. There are 13 businesses that are undertaking high-tech development projects, which have become national key engineering projects. For example, the Changfei [7022 7378] Fiber-Optics Cable Corporation, a Sino-Dutch joint venture, has an annual production capability of 50,000 kilometers of optical fiber and 6,000 kilometers of optical cable for an annual output value of up to 100 million yuan. It is now China's largest optical fiber and optical cable factory. In most of the joint venture enterprises, the Chinese side accepts the capital and puts up the technology, as in the case of the Wuhan Industrial University Machinery Factory, which installed the ceramic facilities for production for the Hong Kong Jiqiang [7162 1730] Corporation. As it digests and absorbs the new technologies that derive from the use of the imported facilities and technology, it will be creating its own special technology. When the Hong Kong side decided to invest in setting up a joint venture in Wuhan, the Wuhan Industrial University Machinery Factory invested its technology which amounted to 30 percent of the total investment.

In the Development Zone, the enterprises engaged in the economic development of high technology will be involved in the fields of bio-technology, computer software, fiber-optics communications, lasers, new materials, all of which are front-line industries in the world's new S&T revolution. For this reason, there will be a big payoff. According to statistics, technology accounts for 74 percent of the gain for new high-tech enterprises. Last year, the annual output value per capita was 70,000 yuan, many times higher than the average for the total market. The average annual output value per enterprise was as high as 660,000 yuan.

Why are the Wuhan Donghu Development Zone high-tech enterprises so prosperous? A comrade from the Development Zone management office replied, "Because they have high and new technologies!"

Guidelines for Establishing High and New-Tech Enterprises

91FE0612B Beijing GUANGMING RIBAO in Chinese
1 May 91 p 2

[Document issued by State Science and Technology Commission in March 1991: "Establishment Conditions and Methods for High and New Technology Enterprises in State High and New Technology Industry Development Zones"]

[Text] Article 1. These methods were formulated to implement policy stipulations concerning state high and new technology development zones approved by the State Council and to promote development of high and new technology industry in China.

Article 2. High and new technology enterprises in state high and new technology development zones (abbreviated as development zones) are established in accordance with these methods.

Article 3. Science and technology commissions in provinces, autonomous regions, municipalities directly under the central government, and cities with province-level decision-making authority (abbreviated as provincial and municipal science and technology commissions) are the primary administrative organs of people's governments in provinces, autonomous regions, municipalities directly under the central government, and cities with province-level decision-making authority for work to administer the establishment of high and new technology enterprises in development zones and are responsible for supervising the implementation of these methods. Under the guidance of people's governments and the guidance and supervision of provincial and municipal science and technology commissions, development zone offices are involved in actual management of examination and approval of matters concerning the establishment of high and new technology enterprises.

Article 4. On the basis of the current world S&T development situation, the scope of high and new technology is classified thusly:

1. Microelectronics science and electronic information technology
2. Space science and aerospace technology
3. Photoelectronic science and integrated photo-electromechanical technology
4. Life sciences and bioengineering technology
5. Materials science and new materials technology
6. Energy science and new energy resources, high-efficiency and energy-conserving technology
7. Ecological science and environmental protection technology
8. Earth science and marine engineering technology

9. Basic material science and radiation technology

10. Medical science and biomedical engineering

11. Other new techniques and technologies applied on the traditional industrial foundation.

These high and new technology realms will be supplemented and revised based on continued development of high and new technology in China and foreign countries and will be announced by the State Science and Technology Commission.

Article 5. High and new-tech enterprises are knowledge-intensive and technology-intensive economic entities. High and new-tech enterprises in development zones must have the following conditions:

1. Be engaged in research, development, production, and business services for one or more high technologies and their products within the scope of stipulations in Article 4 of these methods. This excludes simple commercial business.

2. Implement independent accounting, make their own business decisions, and have responsibility for their own profits and losses.

3. Responsible people in the enterprises are S&T personnel who are familiar with product research, development, production, and administration in their enterprise and are full-time personnel in their enterprise.

4. S&T personnel with educational backgrounds at the college level and above account for more than 30 percent of the total number of enterprise employees; S&T personnel engaged in high and new-tech product research and development account for more than 10 percent of the total number of enterprise employees.

In labor-intensive high and new-tech enterprises engaged in high and new-tech product production or services, S&T personnel with educational backgrounds at the college level and above account for more than 20 percent of the total number of enterprise employees.

5. Must have over 100,000 yuan in capital and business sites and facilities corresponding to the scale of their business.

6. Expenditures on R&D concerning high and new technologies and their products account for over 3 percent of the enterprises' gross annual income.

7. The gross income of high and new-tech enterprises is generally comprised of technical income, output value of high and new-tech products, output value of regular technical products, and related technical trade. The sum of the technical income and output value of high and new-tech products in high and new-tech enterprises accounts for more than 50 percent of the gross annual income of the enterprises.

Technical income refers to income for high and new-tech enterprises from technical consulting, technology

transfer, technology shareholding, technical services, technical training, technical engineering and design, contractual responsibility, technology exports, digestion and absorption of imported technology, and intermediate testing products.

8. They have a clear enterprise charter and strict technical and financial management system.

9. The business life of the enterprise exceeds 10 years.

Article 6. Applications to establish high and new-tech enterprises must be submitted to development zone offices. After examination by the development zone offices, provincial and municipal science and technology commissions approve the issuance of high and new-tech enterprise certificates.

Article 7. Development zone offices should make scheduled inspections of high and new-tech enterprises in accordance with the conditions in Article 5 of these methods. High and new-tech enterprises that do not satisfy these conditions should not enjoy the various policy stipulations concerning state high and new technology industry development zones.

Article 8. The time period for listing as high and new technology products is generally 5 years. High and new-tech products with longer technical cycles be extended to 7 years with approval.

Article 9. Changes in the business scope, combination, separation, shifts to other industries, moving, or shut-downs of high and new-tech enterprises must be examined and approved by development zone offices and the corresponding registrations must be handled at industry and commerce, taxation, and other departments.

Article 10. Within development zones, scientific research units under ownership by the whole people which completely reduce their administrative expenditures to implement economic independence in accordance with state stipulations and which conform to the conditions in Article 5 of these methods can be examined and approved by the development zone office for transformation into high and new-technology enterprises.

Article 11. These methods replace the former "Provisional Stipulations Concerning High Technology and New Technology Enterprise Establishment Conditions and Standards" promulgated by the State Science and Technology Commission.

Article 12. All provincial and municipal science and technology commissions should formulate detailed principles for implementation of these methods. Former detailed implementation principles which do not conform to these methods should be revised according to these methods.

Article 13. The State Science and Technology Commission is responsible for interpreting and revising these methods.

Article 14. These methods go into effect on the day that they are approved by the State Council.

Provisional Policy for Governing High and New-Tech Industrial Zones

91FE0612C Beijing GUANGMING RIBAO in Chinese 1 May 91 p 2

[Document issued by State Science and Technology Commission in March 1991: "Certain Provisional Policy Stipulations Concerning State High and New Technology Industry Development Zones"]

[Text] Article 1. These stipulations were formulated to provide additional support for construction of state high and new technology industry zones and promote the development of high and new technology industry.

Article 2. These stipulations are suitable for use in high and new-tech enterprises established in state high and new-tech industry development zones in accordance with the "Establishment Conditions and Methods for High and New Technology Enterprises in State High and New Technology Industry Development Zones" formulated by the State Science and Technology Commission.

Article 3. These stipulations include all types of preferential policies with the exception of taxation policies.

Article 4. Questions of tariff preferences for imported and exported goods are to be handled in accordance with these stipulations:

1. Raw materials and components imported for production of export products by high and new-tech enterprises established in high and new-tech industry development zones are not required to have import permits and customs is responsible for examining and accepting the export contracts and the approval documents from high and new-tech industry development zones.

2. With customs approval, high and new-tech enterprises can establish bonded warehouses and bonded plants in high and new-tech industry development zones. Customs can provide exemptions from import tariffs and import link product taxes and added value taxes in accordance with stipulations concerning the import of materials for processing and the actual amount of processed exports.

3. Export products produced by high and new-tech enterprises are exempted from export tariffs with the exception of exports restricted by the state or products for which there are other stipulations.

4. The shift of bonded goods to domestic marketing must be approved by the department which did the original examination and acceptance and customs permits and taxes must be paid according to regulations. Among them, products for which the state has implemented quotas or those managed by import permits must report and go through import procedures and apply for import permits in relevant stipulations of the state.

5. Instruments and equipment used for high and new-tech development by high and new-tech enterprises but which China is incapable of producing must receive approval documents from examination and acceptance departments and after examination and acceptance by customs, they are exempted from import tariffs.

When customs feels it is necessary, it can establish organs or assign supervision and management groups in high and new-tech industry development zones to manage import and export products.

Article 5. Stipulations concerning import and export business.

1. Technology import and export companies can be established in high and new-tech industry development zones after receiving approval from the Ministry of Foreign Economic Relations and Trade to promote the entry of high and new-tech products into international markets.

2. Foreign trade management rights can be given to high and new-tech enterprises which have developed export businesses rather well in accordance with relevant state stipulations. Based on business requirements and with approval by the relevant departments, high and new-tech enterprises can establish subsidiary organs in foreign countries.

Article 6. Stipulations concerning capital and credit.

1. Banks can provide active support to high and new-tech enterprises and try to arrange for the capital they require for their development, production, and construction.

2. Banks can arrange long-term bonds in specific amounts for high and new-tech industry development zones, raise capital from society, and support the development of high and new-tech industry.

3. The relevant departments can establish risk capital funds in high and new-tech industry development zones for use in developing products which involve substantial risk. High and new-tech industry development zones with more mature conditions can establish risk capital companies.

Article 7. Productive and administrative capital construction projects of high and new-tech enterprises arrange construction according to unified plans and are given preference for inclusion in the local fixed assets investment scale.

Article 8. With approval by local people's governments, high and new-tech enterprises can be exempted from purchasing state key construction bonds.

Article 9. For the high and new-tech products developed by high and new-tech enterprises, all which attain the level of similar import products in every index and have a definite production scale can be included on state restricted import commodity lists after examination and

approval by the State Science and Technology Commission in conjunction with relevant departments, and imports can be restricted in accordance with current import management methods.

Article 10. With the exception of special types of products which must be reported to materials pricing departments for price determination, for new products developed by high and new-tech enterprises which have state-controlled prices (including state fixed prices and state guidance), within the stipulated period of trial marketing, enterprises can formulate their own trial marketing prices and report them to materials pricing departments and business administration departments for recording. Enterprises can set their own prices for high and new-tech products which do not fall under state-controlled prices.

Article 11. Rapid depreciation can be carried out for instruments and equipment that high and new-tech enterprises use in high and new-tech product development and high and new-tech product production.

Article 12. When it does not affect the portion of revenues turned over to central authorities and with approval by the local people's government, 1990 is used as the base year for all taxes paid by high and new-tech enterprises in high and new-tech industry development zones and increases are returned to high and new-tech industry development zones for a period of 5 years for use in development zone construction.

Article 13. Commercial and technical personnel in high and new-tech enterprises who go abroad several times during a single year are implemented in accordance with State Document No 9 (1990).

Article 14. When regions and departments are making arrangements for labor employment and employee recruitment, preferential consideration should be given to the requirements of high and new-tech enterprises for undergraduate students, graduate students, students studying abroad, and experts who have returned to China.

Article 15. With approval by the state, provinces, autonomous regions, municipalities directly under the central government, and cities with province-level decision-making authority where high and new-tech industry development zones are located can formulate concrete implementation methods in accordance with these stipulations.

Article 16. The State Science and Technology Commission in conjunction with relevant departments will make inspections of high and new-tech industry development zones on a fixed schedule. Implementation of preferential policies will cease for state high and new-tech industry development zones which are poorly managed or which make slow progress and their qualifications as state high and new-tech industry development zones can be eliminated.

Article 17. The State Science and Technology Commission and relevant departments are responsible for interpretation of these stipulations.

Article 18. These stipulations go into effect on the day that they are approved by the State Council.

State Council Approves Funds For High-Tech Zones

91FE0559E Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 6 Mar 91 p 1

[Article by reporters Wang Jianmin [3769 1017 2404] and Han Yuqi [7281 3768 3825]: "1.5 Billion Yuan in Capital Construction Indices To Be Arranged Each Year For High and New Technology Development Zones"]

[Text] With State Council approval, 1.5 billion yuan in capital construction indices has been arranged for local areas to raise themselves each year starting in 1991 and the China People's Bank will arrange substantial corresponding capital construction loan indices to be used for construction of high and new technology industry development zones.

Officials in the State Science and Technology Commission stressed that all provincial and municipal science and technology commissions and development zones must actively fight for support in the areas of capital construction scales and construction capital from local planning commissions and financial, banking, and other departments. All areas must concentrate on making good preparations in all areas of work in advance of construction. Plans call for selecting construction projects where the construction conditions are already in place among the high and new technology industry development zones that have been approved by the State Council to provide preferential support during 1991. All development zones must formulate capital construction plans for the Eighth 5-Year Plan and the next 10 years to enable China's high and new technology industry development zones to form a substantial scale, contribute to China's economic development, and contribute to moving China's high-tech products onto the international stage.

Already, 36 of China's large and medium-sized cities have established relatively independent high and new technology industry development zones in knowledge-intensive regions and they are providing support via the corresponding preferential policies for the development zones. Statistics indicate that China has now established nearly 2,500 high and new technology enterprises in the various development zones.

Tax Policy for High and New-Tech Industrial Zones

91FE0612D Beijing GUANGMING RIBAO in Chinese 1 May 91 p 2

[Guidelines Issued by State Science and Technology Commission in March 1991: "Tax Policy Stipulations for State High and New Technology Industry Development Zones"]

[Text] Article 1. These stipulations were formulated to promote the healthy development of China's high and new technology industry and further spur construction of high and new-tech industry development zones.

Article 2. The scope of application of these stipulations is restricted to high and new-tech enterprises (abbreviated as development zone enterprises) established in high and new-tech industry development zones (abbreviated as development zones) approved by the State Council.

Article 3. The establishment conditions and standards for development zones and development zone enterprises and the scope of high and new technology and their products are implemented according to unified stipulations formulated by the State Science and Technology Commission.

Article 4. Development zone enterprises receive a 15 percent reduction in income taxes starting from the day they are established.

Article 5. When the output value of development zone enterprise export products exceeds 70 percent of the gross output value during a particular year, they can receive a 10 percent reduction in income taxes after examination and approval by tax organs.

Article 6. Newly-established development zone enterprises which make enterprise applications and receive approval from tax organs are exempted from income taxes for 2 years beginning with the year they go into operation.

With enterprise application to tax organs for approval, newly-established development zone enterprises that are Chinese-foreign joint ventures and which have a joint venture period in excess of 10 years can be exempted from income taxes for 2 years starting from the year they become profitable.

Development zone enterprises within the scope of special economic zones and economic technology development zones which are foreign investment enterprises still implement the various taxation policies for special economic zones or economic technology development zones and are not restricted by the two previous stipulations.

After the tax exemption period has ended, in cases where there are truly difficulties in paying taxes, appropriate tax reduction or exemption arrangements can be made for a specific period after receiving approval.

Article 7. For development zone enterprises established by Chinese investments, their income from conducting technology transfers and technical consulting, technical services, and technical training related to technology transfers that occur during the technology transfer process and which have net annual incomes under 300,000 yuan can be temporarily exempted from collection of income taxes. Income taxes are to be collected at an appropriate tax rate for that portion over 300,000 yuan. Income taxes are not collected on any high and new-tech products that fall within the scope of "Spark" Plan development and that conform to new product tax reduction and exemption conditions and which received product tax and added value tax reductions or exemptions according to stipulations and which can be used as special items for technical development.

Article 8. Tax reductions or exemptions for development zone enterprises established through Chinese investments are unified to serve as state support funds, with independent accounting, and the relevant departments supervise the use of special items for high and new-tech product development.

Article 9. For development zone enterprises which are joint venture enterprises, the profits allocated to investors should pay income taxes or turn over profits to higher authorities after deducting taxes paid to the development zones according to the financial system of the investing enterprises.

Article 10. All development zone enterprises established through Chinese investments pay bonus taxes according to current state stipulations. However, bonus taxes are not collected from these individual types of bonuses:

1. Bonuses taken out of net income from technology transfers, technical consulting, technical services, and technical training, not to exceed 15 percent;

2. Bonuses awarded to employees from export bonus funds according to state stipulations in high and new-tech product exporting enterprises, not to exceed 1.5 months of standard wages;

3. Other tax-exempt bonuses which conform to state stipulations.

Items (1) and (2) above are combined to compute the annual average tax-exempt bonus amount. Those which are less than 2.5 months of standard wages are taxed according to deduction of 2.5 months of standard wages. Those which exceed 2.5 months of standard wages are taxed according to the actual tax-exempt bonuses.

Article 11. For development zone enterprises established through Chinese investments, the capital they raise themselves to build new buildings for technology development and production administration are exempt from construction taxes (or investment direction regulation taxes) in accordance with state industry policies.

Article 12. Loans to development zone enterprises are all to be repaid after payment of income taxes.

Article 13. Non-development zone enterprises in development zones which are implemented according to stipulations in current state tax collection policies are not implemented according to these stipulations. When changes occur in the situation of originally established development zone enterprises and they no longer conform to the standards and conditions of development zone enterprises, they no longer implement these stipulations.

Article 14. All tax collection policies in the past which conflict with these stipulations are abolished and changed to implementation according to these stipulations.

Article 15. The State Tax Bureau is responsible for interpreting these stipulations.

Article 16. These stipulations go into effect on the day they are approved by the State Council.

Measures To Promote Young Scientists Proposed

91FE0559F Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 14 Mar 91 p 1

[Article by reporter Liu Yuan [0491 1254]: "State To Adopt Special Measures To Support Growth of Middle-Aged and Young Specialized Technical Personnel"]

[Text] Over the past several years, for various reasons an irrational structural distribution has existed in China's specialized technical staffs, especially in several institutions of higher education and high-level scientific research organs. The average age of key expert technical staffs has been high and this has had negative effects. To solve these problems, the State Council Office has passed on its Personnel Department's "Views on Reinforcing Specialized Technical Staff Construction and Promoting Rapid Growth of Middle-Aged and Young Specialized Technical Personnel".

The "Views" stress that if we wish to encourage young specialized technical personnel to go to the frontlines of agricultural production in hardship and poor regions, in the future we must improve their treatment and assign them specialized technical duties. In the area of cadre hiring choices, preferential consideration should be given under equal conditions to specialized technical personnel who have worked on the front lines for long periods, been trained through substantial practice, and made positive contributions.

The "Views" also pointed out that we should not intervene in allowing middle-aged and young key specialized technical personnel to assume heavy burdens and provided focused training and heavy responsibilities in a planned manner for middle-aged and young specialized technical personnel with good ideological working styles and positive work efforts. All regions and all departments should undertake echelon construction of disciplinary and technical leaders in a planned manner and create all the required conditions for them to grow quickly and become acknowledged by society.

The "Views" stipulate that regions, departments, and units with the proper conditions should provide the required funds for key young specialized technical personnel to undertake scientific research work independently by adopting the establishment of special youth funds and other measures. When establishing projects and topics for all types of S&T funds, they should usually attract participation by at least one-third who are young specialized technical personnel. Superior quality middle-aged and young specialized technical personnel with good political qualities and high professional levels, especially those who have made achievements on the front lines of education, scientific research, medicine, and production, should be chosen for opportunities to go to foreign countries for additional training and cooperative exchanges.

The "Views" also pointed out that superior quality middle-aged and young specialized technical personnel

with literary and artistic talents who have made prominent contributions should be promoted according to appointment conditions stipulated by the state without being subjected to restrictions by history of study, qualifications and record of service, and so on. Specialized technical personnel under 35 years of age who have the corresponding job appointment qualifications should be promoted to assistant professors, assistant researchers, assistant head physicians, senior engineers, and senior agricultural technicians. Specialized technical personnel under 40 years of age should be promoted to professors, researchers, and head physicians. Those promoted to professors, researchers, and head physicians and who have passed examination and approval by province and ministry-level personnel departments can be assigned by province and ministry-level personnel departments to grass-roots level units within their region or department within the scope of their overall indices without taking over grass-roots level units' specialized technical job quota indices. The problem of assigning personnel can be solved by increased allocations of special project indices.

We should actively do good work to attract personnel with superior skills. Graduate students who have received Ph.D.s in China and foreign countries and post-doctoral graduate students who have fulfilled their posting schedules can be accepted by all units without being subject to regional and industry restrictions if they simply have the proper specializations and are needed for work. For personnel who have completed their studies abroad and returned to China, we should actively create the required working and living conditions for them.

Nurturing Young Scientists Emphasized

91FE0719A Beijing ZHONGGUO KEXUE BAO [CHINESE SCIENCE NEWS] in Chinese 25 Jun 91 p 2

[Article by Ren Chuanzong [0117 0278 1350]]

[Text] Because of the effects of the Cultural Revolution and various other factors, the structure of specialist and technical units is out of proportion, the core-group of middle-aged and young professionals is deficient, lack of continuity becomes more evident each day, and it has become a serious obstacle to the building of specialist and technical units that urgently needs to be removed.

The situation overall is that these problems exist in varying degrees in specialist and technical elements in all industries, in major schools, research units, and particularly in the higher level research organizations of engineering, technology, health, and agriculture. The primary manifestations of these problems are:

(1) The ratio of 35 to 46 year old specialists and technicians among specialist and technical units is low, and this is especially reflected in the big-5 series: engineering, technology, agriculture, health, and higher education. Taking major schools and scientific research

organizations for example, in 1988, the ratio of specialists and technicians in this age group made up 14.5 and 18 percent, respectively. In other sectors and units the situation is even more serious.

(2) Professionals in high level specialist and technical occupations are getting older. In 1989, the average age of all high level specialists and technicians in China was 53, and 10 years later over 80 percent of them will have reached the age of retirement. The ratio of those under 40 in high-level specialist and technical occupations in the big-5 series, mentioned above, will be 0.12, 0.53, 0.56, 0.2, and 0.7 percent, respectively.

(3) Now, middle-aged and young specialists and technicians already make up nearly half the total. Although among them are those who excel as high-quality S&T leaders, professional standouts, and technical stalwarts, they are too few in number. In all disciplines and specialties we are faced with the task of replacing the old with the young at all levels of science leaders and key professionals.

In looking at the quality of middle-aged and young specialists and technicians, professional quality, practical ability, level of social recognition, and academic standing is lacking compared with the older generation specialist and key technicians and leaders; another consideration is that political thought, S&T attitudes and work habits of many of them must be brought up to a higher level. Particular attention must be given to the influence of events of recent years; some of them are uneasy about their jobs, and there is a steady increase in "interests abroad" and "business fervor". Looked at from this angle, the problem of the "generation gap" is widespread.

Facing this situation, as respects China's specialist and technical units, many experts and academicians are making an earnest appeal for quick and effective measures to speed the growth of talent among middle-aged and young specialists and technicians, otherwise, by the end of the century, China's S&T endeavors will be facing a perilous situation.

For over 10 years, the party and country have done much work to reform the S&T and educational organization systems and personnel systems. A series of policies and measures have been formulated and implemented for a rational deployment of talent, continued education, and specialist and technical occupational assignments. Systems for training excellent high-level talent and post-doctoral research, administrative systems for selecting stand-out contributors, and national youth S&T funding systems have been established one after the other, with visible successes. For all that, to a certain degree, it has given esteem to knowledge, and created a social atmosphere of esteem for excellent talent, and pushed forward a healthy growth of exceptional talent; but, after more than 10 years, the pressures that led to reforms in the first place are still in evidence, and they demand a search

into the deeper reaches of the real social causes of the "generation gap" which persist and grow more serious with each passing day.

The damage to the establishment of China's specialist and technical units that was caused by 10 years of the Cultural Revolution was so great that some of it can't be remedied. The gap in the structure has a definite historical reality and latent after effects, it is an issue that begs its moment of attention. But, the effects of those 10 years on the establishment of China's specialist and technical units, in the long run, is not merely the lack of training of a generation, it must be acknowledged that in respect of advancing specialists and technicians to higher positions, the phenomenon of seniority still exists; in allocating tasks and funds for scientific research, and granting incentive awards and commendations, the middle-aged and young talent will still, to a certain degree, be held back and passed over.

There are other questions, such as talent pools that remain to be fully settled. At present there are specialist and technical work tasks that aren't filled; there is serious waste in manpower resources. A 1988 national random survey showed that the utilization rate for specialist and technical manpower resources was only 65.59 percent.

The tendency to simplify or be one-sided must be avoided. A study of the "talent gap" can't be restricted to age, occupation or education. Putting great effort into nurturing and selecting middle-aged and young specialist and technical talent should not be done merely to adjust or replenish the present specialist and technical units' age, reputation, education, or distribution structure. The ultimate purpose is, through these efforts, to further promote the establishment and perfection of a system and an environment that is beneficial to the growth of all kinds of talent.

Deng Xiaoping said early on that there must be an environment conducive to the emergence of talent. The growth of talent cries out for reform, and only through reform can the problem of talent growth be truly resolved.

Many specialists and technicians, especially the academic giants, will be leaving their positions in the near future. Will the middle-aged and young specialists and technicians be able to step in and take on the tasks others will be leaving behind? Will the overall level of China's specialist and technical units be able to stay ahead of the landslide?

First, It is better to overestimate this problem somewhat than to underestimate it. The next 5 to 10 years will be the most critical decade for achieving strategic targets for China's economic and social development, and to a certain degree it depends on whether China can smoothly manage the succession of the old by the young. Even as the 21st Century arrives, whether China is still in the throes of catching up and surpassing advanced world levels, or whether Chinese S&T will have reserve

strength, to a certain degree, will be determined by how well China deals with this question. Next, a dialectical approach must be taken in making a complete evaluation of China's specialist and technical units. Overall, there is a pretty good and widespread foundation of young specialist and technical units everywhere, especially since many university students, Masters and Phd graduates trained in recent years have been transferred to specialist and technical units. The worker-peasant-soldier university students of the Cultural Revolution period have done their work, and by their own grit, have raised their professional levels and working abilities. Some of them have become the stalwarts in various occupations and professions. It should be noted that a new body of young academicians has grown up, and they have taken on the responsibilities of academic leaders. There are also a fair number of middle-aged and young specialist and technical talents with excellent training prospects who are awaiting further training. For example, the Shanghai foreign language college decided to have a corp of class leaders in reserve, a special policy was adopted, and over a period of 6 years 154 students were picked out for training. Now the first group of 18 reserve course leaders has emerged. Nankai University most recently broke with the rules and appointed 6 professors under the age of 45 and 14 assistant professors under the age of 35. They have all become widely recognized outstanding academicians.

This is practical evidence that China has no reason to doubt the professional quality or creativity of the middle-aged and young generation. The "generation gap" is a crisis, but it is also an opportunity. The future is an increasingly onerous and heavy burden, and as soon as possible it should be placed on their shoulders. Clearly it presents a chance for them to develop their talents quickly.

As to the question of how to get this accomplished, there are those who have suggested taking the approach of "moving the peaks to fill the valleys", namely, a suitable retention of the old, rational use of the middle-aged, and accelerated training of the young. All of these approaches must be taken. They are feasible. But, the young are China's future, and in the long view, China's S&T development, even more, requires a large number of young academicians and science and professional leaders who can organize and lead. This is the key to solving the

talent gap. A special project support plan must be implemented now, to take the accelerated selection and nurturing of exceptional middle-aged and young specialists, technicians, and leaders of scientific disciplines, and make that a part of the main effort, which is to establish specialist and technical units. The following steps must be taken to accomplish this.

- (1) Strengthen patriotic and socialist education, and throughout their work, let that become their correct world view and outlook on life. Build a sense of commitment and responsibility, and cultivate a earnestly inquisitive and genuine scientific manner.
- (2) Allow the competent middle-aged and young specialists and technicians to take on the difficult jobs to help their talents grow through actual work experience, and a training program for the exceptional middle-aged and young must be planned and specific, and they should be given responsibilities.
- (3) Create conditions necessary for raising the academic standing and social recognition of the middle-aged and young specialists and technicians. Actively move them to the forefront, absorb the exceptional into various level academic groups and committees. Commend and award the outstanding contributors.
- (4) Dispense with seniority. The talented and outstanding contributors should be rated in accordance with their actual work level, and not restricted according to their academic history or time-in-grade. They should be advanced according to national stipulated positions, and there should be support for independent developmental scientific research, and there should be requisite monetary assistance.
- (5) Fully make use of the experience of the old specialists and technicians. Just as Zhou Guangzhao said, the older generation scientists must be as solicitous toward the middle-aged and younger generation as they are to their own children.

Besides accomplishing all of this in good order, it must be noted that the nurturing of talent is an exceedingly complex societal effort. The whole society must participate and cooperate in its various aspects, the specialist and technical personnel administrative sector, the education sector, the economic and S&T sectors, all must be mindful of the strategic importance of this endeavor.

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